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A Valuable Work

EACH passing year, since the Committee on Stresses in Track brought out its first progress report, affords further evidence of the practical value of this scientific investigation. Probably the greatest direct result obtained thus far was derived from the demonstrated advantage of canting rails; which, coming as a scientific corroboration of a growing trend of opinion, gave a marked impetus to the general adoption of this practice. The influence of the findings of this committee are to be noted also in the design of equipment. This may be of an exceedingly indefinite nature, but when it is recalled that the discovery that stresses in track under locomotive trailing wheels was followed by the development of new types of locomotives in which two trailer axles are provided instead of one, it is fair to infer that the builders had given some weight to the committee's work. But more ambitious applications of the fruits of their investigations are under way, one of the most definite being a series of studies designed to ascertain the inter-relation of track construction, and traffic and track maintenance expenses. The work which the committee is now pursuing with respect to rail joints ought also to prove of great value. But as in all research, the preliminary work, necessary to develop the fundamentals, must be thoroughly mastered before material having a commercial significance can be evolved.

Study of Rail Joints and Rail Battering

THE behavior of rail joints and the battering and chipping of rail ends has long occupied the attention of engineers and others who have the responsibility of track maintenance. It would not be fair to say, as Mark Twain remarked of the weather, that "everybody talks about it, but nobody does anything about it," for much constructive work on these subjects has been done in the past. However, it is safe to say that no investigations have ever been conducted with the same attention to broad principles, and at the same time to detail, as those conducted by Past-President Hunter McDonald on the Nashville, Chattanooga & St. Louis, the results of which are embodied in a monograph by Mr. McDonald, presented to the association. The field work incidental to these investigations was inspected by the Special Committee on Stresses in Railroad Track, which is now making investigations and experiments to determine the intensity and distribution of stresses in the rail joint and in the rail at the joint. The information in Mr. McDonald's monograph, together with the data developed by the special committee when it shall be available, should do much to improve conditions in these important particulars.

Contribution of the Engineer

MR. BEATTY'S address last night was an interesting and inspiring discussion of the engineer's work and a tribute to his achievements, particularly in America. Engineering is not new. Engineers, whether so-called or not, superintended the construction of the pyramids in Egypt, the roads and aqueducts of the Roman empire, and other monumental work of ancient times which for centuries have excited the wonder of mankind and even now cause "we moderns" to marvel. But, in a very real sense, the engineer is peculiarly a product and a producer of our own times. Within the last century the development of science has made it possible for him to achieve far more than was achieved through engineering in all previous history. The great things his work has done have been to greatly reduce the burdens of mankind and enormously increase its comforts and luxuries. Engineering has made it possible, in all countries having a modern civilization, for men to get their living with greatly reduced physical effort, and for all classes to get a vastly better living, measured by every material standard. From a material point of view the development of modern engineering has been the most important development in the history of mankind. And in no other field has the engineer made a greater contribution to human welfare than in that of railroad trans-

portation. Only the development of engineering in its various branches has made the railroad possible; and the railroad has rendered possible most of the contributions to material progress that have been made by engineering in other fields. The railroad engineer does not flatter himself if he regards himself as belonging to a profession whose work has been in the past, and so far as anybody can see will be in the future, indispensable to what is very definitely meant by the words "modern civilization."

Track Elevation Work

THE report of the Committee on Signs, Fences and Crossings relating to grade separation calls attention to the advantage of intermediate supports in street subways but fails to bring out the vital significance of this factor in track elevation development. This matter of the right to place posts at the curb lines or the center of the street or at both locations is definitely bound up with the question of bridge floor thickness and in extreme cases may even determine the spacing of tracks. The close inter-relation of these three matters is in most cases the controlling factor in the decision as to the type of structure to be adopted at the street crossing.

Floor thickness in a bridge carrying tracks over streets represents the sum of the thicknesses of three component parts, the load-carrying structure, the waterproofing and the track structure. In earlier days the total was often reduced by resort to special construction in which the rails were carried directly on the structural members of the floor, but experience has demonstrated that this is poor economy. As a consequence a rather well defined minimum has been established for the depth required by the waterproofing and track structure (ballasted) so that in most cases variations in total floor thickness occur only by reason of changes in the design of the load-carrying portion of the floor construction.

The simplest, and generally the most advantageous, bridged construction for track elevation work is one in which the superstructure consists of longitudinal beams. These may be of wood, steel or concrete or combinations of steel and concrete. The primary advantage of this construction is that it places no limitation on the location or spacing of tracks and permits turnouts or crossovers to be installed, removed or shifted at will. Usually also the problems of structural design are simpler than in other types of construction. Waterproofing is also effected with less difficulty.

In structures of this type floor thickness is a function of the span length and unless a sufficient number of intermediate supports is permissible to keep span lengths within reasonable limits, the longitudinal floor beam or slab construction will call for floor thicknesses that are obviously prohibitive. When confronted with these conditions the designer naturally resorts to a floor with transverse beams carried by girders placed between and outside the tracks. In such a design he is enabled to develop longitudinal load-carrying members having a depth equal to the full floor thickness, i. e., from under clearance to top of rail or even a short distance above. But here again he will meet with restrictions based on span lengths, for if the span is too great he will be compelled to give his girders such a depth that he must spread the tracks to avoid fouling the clearance diagram with the top flanges of the girders. Thus the conditions imposing the use of through girders not only fix the location of tracks and prohibit crossovers and turnouts but may even reduce the number of tracks that may be accommodated on the right-of-way.

In view of this, it would seem that a report on grade separation which does not emphasize the advantages of providing intermediate supports in the streets has neglected one of the most vital problems in this branch of railway engineering.

The Masonry Committee on the Joint Committee Report

THE criticism offered by the Masonry Committee of the Joint Committee specifications for concrete must be considered under two heads because a study of the specifications divides naturally between construction and design. Fundamental conditions giving rise to objections to the section on construction bear little relation to those calling forth differences of opinion with regard to the portion relating to design. In fact they may well be considered as two separate specifications—one on the making of concrete and the other on the proportioning of structures to be made of concrete.

The section devoted to materials and workmanship is a distinctive document in that it represents the result of the first concerted effort to incorporate in a general specification the principles of scientific concrete making—the fineness modulus and the water cement ratio. This is not easily done because as a guide for the drafting of practical specifications, the Joint Committee's rules must be stated in the broadest possible terms. It is one thing to prepare rules for the guidance of work conducted under most careful technical supervision, and something different to provide a working control for construction of a more rough and ready order. In the face of these difficulties it is not surprising that the Masonry committee should offer some suggesions for the revision of those parts of the specifications relating to proportioning. As a matter of fact, the changes proposed are not drastic.

Another condition which accounts for some of the objections raised by the A. R. E. A.'s committee is the fact that this association not so many years ago adopted its own specifications for concrete, specifications which represented several years of work and of which it has been justly proud. It is not surprising therefore that the Masonry committee has found occasion to suggest that the wording of corresponding clauses of its own document are superior to those of the Joint Committee's work. On the whole, however, few of the changes proposed are important.

When we turn to the matter of design we find that the situation is entirely different, involving as it does a wide divergence in points of view. This is brought out clearly by the well-known fact that the work of the Joint Committee was dominated by men who, when confronted with a perplexing problem relating to any of its clauses, immediately visualized the application of that clause to a multiple story reinforced concrete building. This influence had its effect on the portion relating to construction, but in the case of design it has made the specification one that relates definitely to such buildings. Further than that it caters to the peculiar business requirements of concrete building designers.

A further criticism is that the Joint Committee has not been sufficiently conservative in the fixing of unit stresses. The Masonry committee has gone on record in this regard. This matter also may find some explanation in differences in points of view and probably is the most difficult one to settle.

Robert W. Hunt & Company have printed the new rail specifications in convenient form which they will be glad to send to any interested railway men.

* * *

T. A. Keefe has been appointed district manager of the Chicago and Pittsburgh offices of the Hazard Manufacturing Company, Wilkes-Barre, Pa., with headquarters at 32 South Clinton street, Chicago.

* * *

T. Ishii, electrical engineer of the Japanese Government Railways, Tokyo, Japan, who is spending several months in the United States studying automatic block signal, interlocking and car retarder systems, was one of the visitors at the Coliseum yesterday.

* * *

L. F. Goodale, formerly chief engineer of the Missouri lines of the Chicago, Burlington & Quincy, died recently at his home in Fort Meyers, Fla. Mr. Goodale was a member of the A. R. E. A. for a number of years until his retirement from professional service.

* * *

The stereoscope installed in the *Railway Age* booth at the Coliseum this year is attracting a lot of attention from the ladies in attendance. For a time we were unable to account for our good fortune but after careful observation, however, we discovered the fact that the interest of the ladies centered in one picture. "Has anyone here seen Kelly?"

* * *

A. O. Cunningham was a visitor at the convention yesterday. Mr. Cunningham is now mayor of University City, Mo., but will be remembered by most of those in attendance as a former chief engineer of the Wabash. Mr. Cunningham reports engineering knowledge and railway experience are being successfully used in running this city.

* * *

It looked on Tuesday and Wednesday as if Chicago was to display real Florida (or Southern California) weather during the convention, to the great disappointment of those who have attended the convention from year to year and who have been accustomed to its snowstorms. However, the weather man redeemed himself yesterday for the customary snowstorms raged throughout the day.

* * *

George Hannauer, vice-president of the Indiana Harbor Belt, and A. E. Clift, senior vice-president of the Illinois Central, have extended a cordial invitation to the Yards and Terminals committee and other railroad members of the association, to visit the Gibson yard on the Indiana Harbor Belt and the Markham yard on the Illinois Central, to observe the operation of car retarders at the hump yards. A special train will leave the LaSalle station at 10 o'clock Friday morning, running over the New York Central Lines to Gibson yard,, returning via the Indiana Harbor Belt to Riverdale and the Illinois Central to Markham yards, and then returning to Chicago, Illinois Central to Van Buren street. Those desiring to make the trip are requested to leave word at the registration desk. The train will return to Chicago about 3:30 p. m.

Signal Appliance Association Elects Officers

At the annual meeting of the Signal Appliance Association on Tuesday the following officers were elected for the ensuing year:

Chairman, W. P. Allen, Union Switch & Signal Co.
Vice-chairman, G. A. Nelson, Waterbury Battery Co.
Secretary-treasurer, F. W. Edmonds.

Members of Executive Committee: Paul Renshaw, General Railway Signal Co., and H. T. Crantford, Electric Storage Battery Co.

In addition, the following members of the Executive Committee hold over: S. G. Johnson, Magnetic Signal Co., W. M. Manuel, Corning Glass Co., J. J. Hubbard, Signal Accessories Corp., John Roberts, General Electric Co., J. W. Young, Kerite Insulated Wire & Cable Co., J. D. Underhill, Okonite Co., and M. J. Fox, Railroad Supply Co.

Important Construction News

Indications continue to develop to show that 1926 will be an active construction year. Among the news released yesterday was a statement by the Reading to the effect that it expects to spend $30,000,000 this year on additional tracks and office space in the Reading terminal, on improvements in terminals on the Philadelphia water front to cost approximately $1,000,000, grade crossing elimination, $6,000,000, on the erection jointly with the Baltimore & Ohio, of a perishable freight terminal at Philadelphia, $10,000,000, on enlargement of the Delaware river ferry service, on shop improvements at Reading, and in the making of preliminary studies for the electrification of its suburban lines at Philadelphia.

The New York, New Haven & Hartford has authorized the construction of a seven-stall extension to an enginehouse at Worcester, Mass., at an estimated cost of $135,000 and the awarding of a contract to the Bethlehem Steel Company for a 100-ft. twin span turntable for installation at Cedar Hill, Conn. The Pennsylvania has awarded a contract to the Newhall Company, Cleveland, Ohio, for the laying of tracks on the Canton-Bayard cut-off at an estimated cost of $700,000. This road has also awarded a contract to A. Guthrie & Company, St. Paul, Minn., for the construction of second track from Casey, Ill., to Shoyer, and from Greenup, Ill., to Montrose, at a cost of $180,000.

The A. R. E. A. Program

Today

Ties	**Bulletin 283**
Economics of Railway Operation	**Bulletin 284**
Roadway	**Bulletin 284**
Wooden Bridges and Trestles	**Bulletin 284**
Wood Preservation	**Bulletin 284**
Clearances—Progress Report	**Bulletin 284**
Economics of Railway Labor	**Bulletin 285**
Buildings	**Bulletin 285**

New Business.
Election and Installation of Officers.
Adjournment.

The Board of Direction in Session Monday.

Second Day of Convention Shows Sustained Activity

Increased registration and controversial subjects keep interest in Wednesday's proceedings at high pitch

THE second day of the convention of the American Railway Engineering Association opened promptly at 9 o'clock with President J. M. R. Fairbairn presiding. The Florentine room where the sessions were held was well filled during both morning and afternoon sessions. The important features of the day's proceedings were the active discussions of the reports of the Committee on Signs, Fences and Crossings and on Rail. Other reports included those on Signals and Interlocking; Yards and Terminals; Uniform General Contract Forms; Masonry; Stresses in Railroad Track; Track and Co-operative Relations with Universities.

Report of Committee on Signals and Interlocking

The Committee on Signals and Interlocking presented a progress report on automatic train control in which historical data was brought up to date. On the subject of highway crossing protection the committee reported that aside from several criticisms based on misconceptions, it had received no criticisms of the requisites which were adopted by the A.R.A. in 1925. The report called attention to the difficulty of standardizing certain requisites owing to the diversity of state laws. It also called attention to the increased numbers of automobiles and the importance of securing the co-operation of public utility commissioners and local authorities in educating careless drivers to use caution at highway crossings. F. B. Wiegand has been chairman of the committee for the past three years.

F. B. Wiegand
Chairman

THE committee submitted reports on (1) Revision of the Manual, stating that no further revisions were to be offered at this time; (2) Automatic Train Control in Appendix "A," and (3) Signals for Highway Crossing Protection in Appendix "B" and recommended that the reports be accepted as information and that the requisites for automatic crossing protection included in Appendix "B" be approved for publication in the Manual.

Committee—F. B. Wiegand (N. Y. C.), chairman; B. T.

Anderson (C. & O.), vice-chairman; H. S. Balliet (N. Y. C.), W. E. Boland (S. P.), W. J. Eck (Sou.), W. H. Elliott (N. Y. C.), G. E. Ellis (A. R. A.), J. V. Hanna (K. C. T.), J. C. Mock (M. C.), H. G. Morgan (I. C.), F. P. Patenall (B. & O.), J. A. Peabody (C. & N. W.), F. W. Pfleging (U. P.), W. M. Post (Penna.), A. H. Rudd (Penna.), Thos. S. Stevens (A. T. & S. F.), E. G. Stradling (C. I. & L.), W. M. Vandersluis (I. C.), and R. C. White (M. P.).

Automatic Train Control

In the report submitted at the March, 1925, meeting, the historical data was given pertaining to this subject including a copy of I. C. C. order No. 13413 and the extent to which wayside signals may be omitted in train control territory. The Committee has kept informed on this subject and submitted Appendix "A" in which was given a series of tables compiled from information in the files of the Committee on Automatic Train Control of the American Railway Association. The report included the mileage of the first I. C. C. order; permanent installations completed or in service; permanent and preliminary installations under construction; contracts executed; devices selected by carriers in the first order; track miles of automatic train control to be installed under way, and a list of the inspections of such installations by the Interstate Commerce Commission.

(The several orders and opinions issued by the Interstate Commerce Commission, as well as the reports of inspections of the various train stop and train control installations in service, have been published currently in the *Railway Age*, while the recently compiled composite analysis of the status of different installations was included in the issue of January 2. The analysis of train accidents, also included in the report of the committee, was given in the report of Committee X—Signaling Practice of the Signal Section, published in the daily edition of the *Railway Age* for March 10. This report is, therefore, omitted here.—EDITOR.)

Appendix B—Signals for Highway Crossing Protection

Aside from the suggestion made by one of the manufacturers to standardize more in detail on range and spread, and several criticisms from active members that the spread specified is not enough, overlooking the requirement that it shall be not less than 3 deg. each side of the axial beam, we have received no criticism of the requisites submitted at the March, 1925, meeting, approved by the Signal section letter-ballot, 1217 to 0, and now A.R.A. recommended practice.

However, a number of new problems have presented themselves and the committee is now engaged in their solution.

First—Requisite 2, covering location, provides that "The railroad standard highway crossing sign and the signal shall be mounted on the same post." That is a good requisite, brief and clear, but does not state where this post should be located.

Pennsylvania requires that the signal be located to give the greatest visibility to highway traffic, preferably in the horizontal line with the driver's eye, when located on the side of the road, and in no case more than 15 ft. above the surface of the highway when mounted over the road. The highway department of that state wants no obstructions in its highways, and the Public Service Commission of the state agrees.

The Public Service Commission of the adjoining State of New York, in its order of June 4, 1925, standardizing on the horizontal flashing type for all new work and renewals, says in part, "The commission hereby recommends the installation of said horizontal flashing type signal in the center of the highway upon each side of the railroad whenever physical conditions at the crossing will permit such an installation to be made."

The boundary line between these states is about 300 miles long, and the highways crossing it are many. North of the line they want the signals in the middle of the road. South of it, on the roadside. Which is preferable? What is the solution?

This is a matter which doubtless comes within the jurisdiction of the Committee on Grade Crossing Protection and Trespassing of the Operating Division, but we believe intelligent discussion and constructive suggestions, if it can formulate any, would not be taken amiss. Of course, the line of least resistance is to comply with the order of any commission without protest, but, by doing this, we throw our long hoped-for and much desired uniformity into the discard.

Arguments for and against the various locations should be produced and carefully analyzed; then recommendatory action taken. It seems to us they are about as follows, although there may be and doubtless are other points to be brought out on both sides:

Advantages of Location at Center of Road

(a) A majority of automobiles have left-hand drive; a careful driver has his eyes focused on the highway, or at least one of them usually is. A signal on the level of his eyes and in the center of the highway is in more direct line of sight than one on the right side of the highway, which may be overlooked.

(b) As it constitutes an obstruction in the highway, it cannot be overlooked, especially if the base is painted black and white, checkerboard style.

(c) The highway must be widened on each side of it. Therefore, drivers must exercise more care in turning out for it than if they had a straight-away road.

(d) A standard location of all such signals should be in the center of the highway and all existing signals should be changed for uniformity, as should all crossing signs, as the obstruction in the middle of the road constitutes additional protection because it draws the attention of the driver to a danger he might otherwise overlook.

(e) With the traveled way widened and improved on account of this location, drivers will naturally follow the traveled way over the railroad at the point they should travel.

(f) It separates the traffic crossing a railroad into two lanes, and to a considerable extent prevents cars from cutting in and passing on the crossing itself.

(g) Cars stopped at a crossing or signal are less liable to interfere with the view, as a driver intending to pass a standing or slow moving vehicle ahead naturally turns to the left into full view of the signal.

(h) It is better for a drunken driver (of which a few sporadic cases are still extant) and his passengers to run into this obstruction than into the path or side of a train which may be approaching.

(i) Advertising and other signs are located at the side of the road; few, if any, in the center. Therefore, the location is distinctive.

(j) Traffic officers to be effective must always be in the center of the street. This signal is a silent traffic officer.

Disadvantages of Location at Center of Road

(a) The signals are run into frequently and put out of service because they are less visible than those located on the roadside.

(b) They obstruct the highway at a point where it should be clear of all obstructions.

(c) As they are illuminated only when a train is approaching, which is only a small part of the 24 hours, on dark nights they are not seen if a car has poor headlights, and many of the heavy trucks have short-range lights.

(d) At some places where they are installed, authorities require overhead or flood lighting and at others colored lights on the base or mast. The Indiana Commission requires one or two red lights at the base of the signal, burning constantly. Other authorities prefer yellow lights, red or yellow flex, Stimsonite, or some other extraneous means for calling attention to the obstruction. Such colored lights

burning constantly detract from the effectiveness of the signal itself. Flood lighting costs money.

(e) For a considerable distance along the road the signal is directly in the line of the driver's eye and the headlights of opposing cars, the glare of which renders it invisible when not lighted and dim when lighted, this perhaps being one of the worst factors.

(f) It is not the province or duty of a railroad to place an obstruction in the highway, especially if liable for damage. One railroad has been sued by a driver who ran into a signal so located. We think there are others.

(g) If placed over the highway, it is hidden by the automobile roof a considerable distance from the crossing and may change its indication after a driver loses sight of it.

(h) It costs somewhat more to install, even if the highway department erects the obstruction, and the cost of widening the street is frequently excessive.

(i) Being an obstruction, it requires the vehicle to turn out. Many authorities are of the opinion that the safest crossing is a straightaway level one, where the driver can give all his attention and thought to the probability of an approaching train.

(j) It is a particularly bad location for the wig-wag, even if one is used with a red light constantly burning.

(k) Cars turning to the left to pass cars ahead are liable to hit the obstruction, especially if opposing headlights form the background.

ADVANTAGES OF LOCATION AT RIGHT SIDE OF ROAD

(a) It does not obstruct the road.

(b) It is in the same relative position as all the other warning or danger signs erected by the highway department and other local authorities.

(c) It is the place the driver by force of habit and education looks for information.

(d) It is usually out of the line of headlight glare.

(e) It is not necessary to render it visible by extraneous lighting when no train is approaching.

(f) As it does not require widening of the street approaching the crossing, it can be placed nearer the railroad in most cases than if in the center and thereby gives the latest possible information to the driver.

(g) It is cheaper to install.

DISADVANTAGES OF LOCATION AT RIGHT SIDE OF ROAD

(a) It may have to be placed so far from the traveled part of the highway that it is entirely overlooked.

(b) If near the road, it may have to be high and perhaps underlooked. The use of the short arm cross-buck sign would greatly reduce if not entirely eliminate both these objections.

(c) Automobiles stopping, especially on the right side of road (where they should stop) for repairs; parking and petting parties may obscure signals from following vehicles, especially those turning to the left and, in a measure, away from the signal, to pass the standing or slow moving vehicle ahead.

(d) Advertising signs are so numerous along the side of the road that people get tired looking at them and miss the real signals.

We need uniformity not only of signals but of their location; as we see it, we cannot get it. Each location should be given special study. With the highway curving sharply to the right, in some cases, in spite of interference of lights from opposing automobiles and even the cars themselves, it will be best located on the left side.

If the roadway and surroundings are well illuminated, as in city streets and especially if the city traffic signs are in the center of the streets and people are accustomed to look there for them, the center of the street is the place for the crossing signals also.

In the open country where power is not available to furnish extraneous lighting, as is the case on the majority of country roads and even on state highways yet, and, where drivers are accustomed to look to the right side of the road for information, signals should be located so as to be seen by such looker, on the right of the highway.

Perhaps as good a rule to advocate as any would be to locate the signal in the center of a street if it is wide enough to do so without great expense, when assured that the local people will not require flood lighting or illuminating it to give a Christmas-tree effect, and to locate it on the side of a road.

We might perhaps get uniformity in the matter of painting, both as to color and the form it should take. We might all agree, for instance, on a black and white checkerboard pattern for the foundation; for an upright, lower half white, upper half black, or for economical reasons all black, or, for appearance sake, black near the ground with white upper works. * * * We should get a uniform standard, or a standard uniform in this particular feature at least.

We certainly should be able to present a united front on the desirability of eliminating advertising signs in the vicinity of railroad crossings, especially within the zone limited by the approach signs and 300 ft. or 400 ft. beyond it; also against the use of fixed red colored lights on the signals when located in the highway.

To further complicate the situation, the New York Times in August, 1925, announced that the Joint Board on Interstate Highways meeting with the United States Bureau of Public Roads, had adopted a system of signs; among which it stated are the following:

"A circular sign 24 in. in diameter with a yellow background and bearing the familiar railroad cross in black with the letters 'RR' also in black in the upper quadrants for use at railroad grade crossings in all states in which existing laws permit the use of such a sign. The board recommends that the use of the sign be authorized by suitable legislation in all sattes.

"The standard stop sign adopted is a regular octagon with the word 'Stop' in black letters on a yellow background.

"A round sign will always indicate a railroad crossing; an octagonal sign will indicate positive danger and will call for a complete stop; a diamond shaped sign will be equivalent to a command to proceed with caution, and a square, yellow sign will call attention to the need for a lesser degree of caution.

"In addition to the warning and cautionary signs, standards have also been adopted for various forms of information and directional signs, all of which are to be rectangular in form and to have a white background with black letters. (No provision is made for the cross buck sign, which the public knows almost universally indicates a railroad.)

"With respect to luminous signs the action of the Board at its April meeting remains unchanged. The colors approved are red for danger or stop, yellow for caution and green to indicate 'Go.'"

On a recent trip west, we noticed two single-track railroads operated jointly as a double-track railroad. At one location, with tracks less than ¼ mile apart, crossed by a highway, one crossing had a two-position wig-wag, the other a three-position wig-wag, each the standard of the particular railroad. One railroad in the East has three highway crossings within four miles, one protected by two Brach flashers, the next by two Hall discs, bells and watchman, and the third by horizontal flashing lights and watchman. The State of Maine requires wig-wag Brach flashers and bells.

One of the big problems is the determination of the point where multiplicity of devices intended to protect introduces such confusion as to actually reduce the protection, as, for instance, flasher and wig-wag and bell; one or another type visible signals and bells; visible signals and/or bells with watchman part time; visible signals and/or bells with watchman full time; and the same conditions with gates added, operated part time or entire 24-hour period, and from these conditions arise various problems which your committee is now considering in connection with the practices of various roads in order to, if possible, recommend the best practice. For example: Several roads install flashing lights where gates are operated part

time; gateman switches the lights on when going off duty and off when coming on duty, on the theory that raised crossing gates are an invitation to cross and, if unattended, tend to cause accidents; therefore, the warning lights are substituted at such times. Other roads do this where a watchman without gates is employed part time. One road did this and paid $20,000 because the watchman had gone on duty and had cut out the lights, but neglecting his work, gave no warning of an approaching train, while the presence of the automatic signal, giving no warning, encouraged drivers to cross.

Many recognize the weakness of depending on the watchman to cut the lights in. One road provides a thermostatic clock; the watchman cuts the signals out when coming on duty and winds the clock; the signals cut in automatically by the clock. In view of damage suit referred to, it is questionable whether the lights should be cut out when the watchman is on duty. If they are, should they be cut over to an indicator giving information to the watchman? This would be comparatively inexpensive, as the track circuits would be in operation whether the signals were cut in or not. * * *

On multiple-track roads, should signals always indicate for reverse traffic as well as assigned traffic direction? Or should they so indicate only on tracks normally operated in both directions? Or is there some point midway where such protection is necessary and, if so, how is it to be established? If indicating in assigned traffic direction only, what protection should be provided in emergency reverse traffic operation?

We had a case in Maryland on a double-track railroad where we never ran trains against traffic normally. However, we had a broken rail and we put a train over on the other track and ran it against traffic. The engineman whistled three times approaching the crossing, the engine bell was ringing, but the highway crossing signal, of course, was not working because the train was running against the current of traffic. It struck three boys and killed them. We have ordered trains running in that way to take extra precautions. That is a matter where the Train Rules Committe can get in its work, because most of the crossing signals are made to operate only in the direction of traffic and not in the reverse direction. There should be some provision made that when trains are running against the current of traffic the trainmen will at such locations take extra precautions. On one road the trainman has to flag every crossing when they run in a reverse direction. The result is that they do not run in the reverse direction very often. How far should the railroads properly go in trying to meet conditions brought about by no fault or action of their own? * * * *

We have a great mass of statistics culled from the Interstate Commerce Commission reports and arranged in various forms, covering fatalities in different classes of accidents, derailments, collisions, miscellaneous, etc., which we shall now not present, and only give a few comparisons of interest.

In the State of Pennsylvania in 1914, about 45 automobiles were smashed at grade crossings and in 1924, 960, or 20 times as many, while less trespassers were hurt and killed; the theory being that those who were in 1914 walking the railroad are now driving "Henry's" in the same happy-go-lucky fashion as they formerly pressed the ties, and getting theirs in increasing numbers.

The National Conference on Street and Highway Safety held at Washington, D. C., December 15 and 16 last year, at the call of Secretary of Commerce Hoover, recognized this condition. We quote one significant paragraph from the report of the meeting:

"The elimination and protection of grade crossings are of such importance and involve to such an extent the public safety as to require that priority be given to them, in the allocation of capital funds by the railroad and of public monies for highway building, over expenditures for other safety measures designed to protect the public."

Requisites for Automatic Signals for Highway Crossing Protection

1. **Aspect**—An electrically or mechanically operated signal used for the protection of highway traffic at railroad crossings shall present toward the highway, when indicating the approach of a train, the appearance of a horizontally swinging red light and/or disc.

2. **Location**—The railroad standard highway crossing sign and the signal shall be mounted on the same post.

3. **Operating Time**—Automatic signal devices used to indicate the approach of trains shall so indicate for not less than 20 sec. before the arrival of the fastest train operated over the crossing. (Note—Local conditions may require a longer operating time, however, too long an operation by slow trains is undesirable.)

Flashing Light Type

4. **Height**—The lamps should preferably be not less than 6 ft. nor more than 9 ft. above the surface of the highway.

5. **Width**—The two lamps shall be mounted horizontally 2 ft. 6 in. centers.

6. **Flashes**—Lights shall flash alternately. The number of flashes of each light per minute shall be 30 minimum, 45 maximum.

7. **Hoods**—Lamp units shall be properly hooded.

8. **Range**—When lamps are operated at normal voltage, the range, on tangent, shall be at least 300 ft. on a clear day, with a bright sun at or near the zenith.

9. **Spread**—The beam spread shall be not less than 3 deg. each side of the axial beam under normal conditions. This beam spread is interpreted to refer to the point at the angle mentioned where the intensity of the beam is 50 per cent of the axial beam under normal conditions.

10. **Lenses or Roundels**—Size shall be 5⅜ in. minimum; 8⅜ in. maximum.

11. **Transmission Values (for Red Lenses and Roundels)**—Based on A.R.A. standard scale, should be 160 to 220 where plain cover glass with reflector is used; 220 to 275 where signals are used without reflectors or where the ribbed spreadlite lens is used in front of the reflector.

12. **Short Range Indication**—Signal shall display a satisfactory short range indication.

13. **Peep Holes**—Peep holes may be used.

Wig-Wag Type

14. **Length of Stroke**—Length of stroke is the length of chord which subtends the arc, determined by the center of the disc in its extreme positions, and shall be 2 ft. 6 in.

15. **Disc**—Size and painting of disc shall be as shown on A.R.A. Sig. Sec. 1553.

16. **Number of Cycles**—Movement from one extreme to the other and back constitutes a cycle. The number of cycles per minute shall be 30 minimum, 45 maximum.

Discussion

[The report on train control was presented by F. B. Wiegand (N. Y. C.), chairman of the committee who moved that it be accepted as information. *Motion carried.*

A. H. Rudd (Penna.), chairman of the sub-committee on Signals for Highway Crossing Protection presented this report stating that he had recently investigated highway crossing signals in middle western states. Mr. Rudd moved that the report be accepted as information and the *motion was carried without discussion.*]

Mr. Wiegand: The requisites for Automatic Signals for Highway Crossing Protection were adopted by the Signal section on letter ballot, 1217 to 0, and are now

the recommended practice of the A. R. A. I move that these requisites be approved for inclusion in the Manual. *Motion carried.*

Mr. Wiegand: The American Engineering Standards Committee on the code of color for traffic signals has completed its report and included in the report are the requisites which you have just adopted. That report has gone to the sponsors for a vote and the highway people and the sponsors are, I understand, opposed to it. The only point of difference is that the committee of which I was a member and the American Engineering Standards Committee recommend a red stop sign with white letters and the highway people want an octagonal yellow sign with black letters, for a stop. I hope they can agree, because the code is valuable and is needed. This explanation is offered as information.

[The committee was excused with the thanks of the Association.]

Report of Committee on Yards and Terminals

The Committee on Yards and Terminals presented for approval a report on scales in which it stated that it had not changed its views that it would be impracticable to attempt to write a general specification for automatic indicating devices for weighing. It presented, as information, reports on the joint use of passenger terminals; freight yard design, with suggestions as to economies in operation; and mechanical means of controlling or retarding the movement of cars in hump yards, describing the various devices now in use, ranging from the hand-applied skate to the elaborate car retarders operated by electric or electro-pneumatic mechanism with data as to economies effected. J. R. W. Ambrose has been chairman of this committee for 2 years and a committee member for 4 years.

J. R. W. Ambrose
Chairman

THE committee submitted a progress report on the Joint Operation of Passenger Terminals in Appendix A, a report on a number of subjects relating to Scales in Appendix B, a first installment of a study on Yard Design in Appendix C and a general report on Mechanical Means for Controlling Cars in Hump Yards. The report on the latter subject was confined primarily to a description of the car retarder installation in the Gibson, Ind., yard of the New York Central, which was described in detail in the *Railway Age* of November 15, 1924. Portions of Appendix B and an abstract of Appendix C are presented below. The committee recommended that Appendix B on Scales be approved and that the other parts of its report be received as information.

Committee: J. R. Ambrose, Tor. Term., chairman; J. G. Wishart, (C. R. I. & P.), vice-chairman; Irving Anderson (A. T. & S. F.), C. E. Armstrong (N. & W.), J. E. Armstrong (C. P.), Hadley Baldwin (C. C. C. & St. L.), H. M. Bassett (N. Y. C.), E. J. Beugler (Con. Engr.), C. H. Blackman (L. & N.), C. A. Briggs (U. S. Dept. Agr.), W. P. Bruce (N. C. & St. L.), R. A. Cook (C. & A.), J. D'Esposito (Chi. Union Sta.), A. W. Epright (Pa.), O. H. Frick (C. M. & St. P.), E. H. Fritch (Am. Ry. Engr. Assn.), Otto Gersbach (Chi. Jct.), A. L. Grandy (P. M.), John V. Hanna (K. C. Term.), M. J. J. Harrison (Pa.), E. M. Hastings (R. F. & P.), R. A. C. Henry (C. N.), J. B. Hunley (C. C. C. & St. L.), H. C. James, Jr. (N. P.), D. B. Johnston (Pa.), B. H. Mann (M. P.), C. P. McCausland (W. M.), J. A. McGrew (D. & H.), A. Montzheimer (E. J. & E.), C. H. Mottier (I. C.), H. L. Ripley (N. Y., N. H. & H.), H. M. Roeser (Bureau of Standards), J. E. Saunders (D. L. & W.), C. H. Spencer (I. C. C.), E. E. R. Tratman (En. News-Rec.), W. M. Whitenton (M-K-T), J. L. Wilkes (Jacksonville Term. Co.).

Appendix B—Scales

Among other matters reported on briefly by the sub-committee on this subject was a Tabulation Covering Combined Commodity and Scale Tolerance for Bulk Grain Transportation in Carloads. The Committee on Weighing of the American Railway Association, at a meeting held at Chicago on September 11, 1925, considered the above question, and tentatively adopted a table of tolerances. This table was subsequently referred through the regular channel to this committee for review and report. The proposed table is as follows:

Loads (Lb.)	Commodity Tolerance	Total Tolerance for Two Hopper Scales	Total Tolerance for Commodity and Two Hopper Scales	Total Tolerance for Two Track Scales	Total Tolerance for Commodity and Two Track Scales	Total Tolerance for Commodity and One Hopper Scale and One Track Scale
60,000	75 lb.	60 lb.	135 lb.	120 lb.	195 lb.	165 lb.
66,000	82 lb.	66 lb.	148 lb.	132 lb.	214 lb.	181 lb.
70,000	87 lb.	70 lb.	157 lb.	140 lb.	227 lb.	192 lb.
77,000	96 lb.	77 lb.	173 lb.	154 lb.	250 lb.	212 lb.
80,000	100 lb.	80 lb.	180 lb.	160 lb.	260 lb.	220 lb.
88,000	110 lb.	88 lb.	198 lb.	176 lb.	286 lb.	242 lb.
100,000	125 lb.	100 lb.	225 lb.	200 lb.	325 lb.	275 lb.
110,000	137 lb.	110 lb.	247 lb.	220 lb.	357 lb.	302 lb.

Column 1 shows the capacity and 110 per cent of capacity of the cars ordinarily used for the transportation of bulk grain.

Column 2 is ⅛ of 1 per cent of the value shown in column 1, representing invisible loss and waste incident to the handling of bulk grain from scales to cars in loading, and from cars to scales in unloading.

Column 3 represents the tolerance for the two hopper scales used, namely, 0.05 per cent for the loading hopper scale, and 0.05 per cent for the unloading hopper scale, or 0.1 per cent for two hopper scales.

Column 4 shows the totals of columns 2 and 3, or the total tolerances applicable for the commodity and two hopper scales used.

Column 5 represents the tolerance when two track scales (each 0.1 per cent) are used, one at the loading point and the other at the unloading point.

Column 6 shows the totals of columns 2 and 5, or the total tolerances applicable for the commodity and two track scales used.

Column 7 shows the total tolerances applicable for the commodity and one track scale and one hopper scale.

It is reported that the results obtained by the Bureau of Standards during the fiscal year 1925 are as follows:

Average numerical per cent maximum error of weighing for all track scales tested	0.27 per cent
Tolerance corresponding to the above	0.20 per cent
Average numerical per cent maximum error of weighing for all track scales tested which were used for weighing grain	0.19 per cent
Tolerance corresponding to the above	0.10 per cent

It is noted in the figures quoted immediately above the actual average errors materially exceeded the tolerances, and the excess was relatively greater in the case of grain-weighing scales.

It is furthermore believed that the figures quoted above should be considered as fairly representative of conditions throughout the United States, as the tests from which the figures were developed were made generally in all sections of the country.

From careful consideration of the foregoing and other facts, it is the best judgment of the committee that the tolerance tabulation quoted above is satisfactory for use in adjusting claims based on alleged disparities in weights of bulk grain in carloads, and that the values shown therein are the best and fairest that can be proposed at the present time.

Appendix C—Freight Yard Design

This report is the first of a series which are to be submitted outlining the information required and the use of that information in determining the proper design of a yard. It is confined to the requirements governing the number and length of receiving, classification and departure tracks only and the determination of the type of yard in which these tracks are to be assembled.

Number of Tracks

The number of receiving tracks should be such that there will be one available whenever an arriving train offers to enter the yard. This number depends upon the arriving time of the trains and upon the average length of time that a train occupies a receiving track. For preliminary purposes it may be assumed that the number of receiving tracks should equal the maximum number of trains normally expected to arrive in a period of two hours.

The number of departure tracks should be such that there will be one available for assembling a departing train whenever necessary. For preliminary purposes it may be assumed that the number of departure tracks should equal the maximum number of trains normally expected to depart in a period of two hours.

The number of classification tracks should be such that there will be one available for each classification to be made in the yard. In addition to the tracks for the ordinary classifications of cars for forwarding beyond the yard, there should be a track for each of the special classifications which may be handled separately within the yard, including bad order, weight, refrigerator, stock, and other cars as required. One or two extra or unassigned classification tracks will also usually be found advantageous. An analysis of the consist of the trains which are to be passed through the yard will usually indicate a possible number of classifications greatly in excess of the number of classification tracks which could reasonably be provided. Conference with the appropriate operating officers will, however, establish a permissible grouping of these separate classifications so as to reduce their number and still adequately meet the requirements of the traffic.

Length of Tracks

The length of the receiving and departure tracks should be such that each will accommodate a complete train, including one or more assisting locomotives where used. The length of the classification tracks should be such that each will normally hold all accumulated cars of the assigned classification until they are to be moved off of the classification track under normal operation and without special movement of switching power. When the expected accumulation of cars of one classification requires an exceptionally long classification track it will normally be advantageous to provide more than one track for that classification rather than a single track of greater length than a departure track.

Total Capacity

The total combined capacity required for the receiving, classification and departure tracks in an average yard may be roughly assumed to be about equal to the total number of cars to be passed through that yard in 24 hours. The capacity of the receiving tracks will be about equal to the capacity of the departure tracks and the sum of these two will be about equal to the capacity of the classification tracks. This distribution is, however, only approximate.

If the total number of cars and the number of switching cuts per train is small a single flat yard, to handle the traffic in both directions, is indicated. If the total number of cars is large but the total number of switching cuts per train is small a single flat yard, to handle the traffic in both directions, or possibly two flat yards, each handling the traffic in one direction only, is indicated. If the total number of cars is relatively small, but they are normally received in a short period of time, and the number of switching cuts per train is large and they must be made promptly so as to pass the cars through the yard in a limited time, a hump yard may be indicated. If the total number of cars is large and the total number of switching cuts per train is also large a hump yard is indicated.

Flat Yards

In a single flat yard the longer tracks will normally be the receiving and departure tracks and the shorter tracks will normally be reserved for classification purposes. Since the two-hour period in which the maximum number of trains arrive from one direction may not coincide with the two-hour period in which the maximum number of trains depart in that direction, and since neither of these periods may coincide with the similar periods for trains in the opposite direction, the total number of receiving and departure tracks, when these tracks are used interchangeably, need not ordinarily equal the sum of these four maximum numbers of trains. Since a yard of this type may usually be worked from both ends and the longer classification tracks may have sufficient capacity to permit of using each end of several of them for a separate classification, the total number of classification tracks need not ordinarily be the sum of the number of classifications to be made in each direction.

With the two yards laid side by side the total number of receiving and departure tracks may be determined in the same manner as for a single flat yard. With the two yards entirely separate, however, a study of the probable arriving and departing time of trains moving in a single direction, and of the time each of these trains will probably occupy a receiving or departure track, will determine the total number of these tracks required in the corresponding yard.

Hump Yard

When a hump yard is indicated it may be required in one direction only, with a flat yard to serve the opposite direction, or a separate hump yard may be re-

quired in each direction. In the exceptional case it may be possible to provide a single hump yard to handle the traffic from both directions over a single hump in one direction and thus secure common use of and, consequently, a minimum number of receiving and of departure tracks. Similar common use of classification tracks cannot be secured, however, for hump yard operation will not permit of mixing, on one track, cars moving in opposite directions, and the full requirement of classification tracks must be provided. A disadvantage of this arrangement is the necessity for the reverse movement through the yard of traffic moving in one of the two directions if the yard is laid parallel to the line of movement, or the necessity for the diversion of all traffic from its normal line of movement if the yard is laid perpendicular to the normal line of movement.

The necessity for separate departure tracks as a part of a hump yard design depends upon whether or not cars of single classifications accumulate rapidly enough to permit of forwarding them in whole trains. Where they do so accumulate the classification tracks may be used as departure tracks until such time as relief must be provided for the classification yard by building tracks on which to move whole trains which are accumulated during periods when freight trains cannot be moved out of the yard and on the main track. Where they do not so accumulate and each train must normally be made up of a number of classifications, the construction of departure tracks in the first instance will permit of building short classification tracks and will facilitate assembling different classifications into a single train.

Discussion

[H. L. Ripley (N. Y. N. H. & H.), chairman of the sub-committee presented the report on Joint Use of Passenger Terminals as a progress report.]

Mr. Ripley: Information was received by the committee on 101 jointly used passenger terminals of considerable magnitude. It is clearly apparent that the practice of using terminals jointly is well established. The committee expects to use the information collected to establish an outline for such a basis of compensation.

Consolidation of terminals may require the building of new track approaches through built-up areas as a rule; delays to train through bunching service in case of delays or late trains may be increased. Congestion, especially of the concourse, for even a short tie-up in the yards from fog and so forth, may result. Increased walking distance to reach facilities and trains may be necessary. Necessity for moving terminal facilities farther away from community center to get sufficient area for development may be experienced. Increased cost to certain carriers now favorably situated may follow. There may be adverse effect on property in the vicinity of the location abandoned, and there may be adverse effect upon some carrier having present strategic advantage of location.

Economic conditions in their broader aspect should be studied, as well as the local conditions which affect the particular project and the specific matters just enumerated. Introduction of the automobile into general use has had a profound effect upon passenger service. Distances from the station, measured in miles, remain the same, but distances measured in minutes are reduced to a fraction. What of the future? At present the number of passengers traveling is decreasing, it has fallen about twenty per cent since 1920, and that decrease has been widely distributed throughout the country. Is the present a transition period in passenger service when it is good judgment to go slow before spending new money on station construction or consolidation of passenger stations?

The taxicab has, in the last ten years, revolutionized travel to and from the station and revolutionized travel between the stations. What of the motor coach in the next ten years? Must the joint passenger terminal of the future be developed to take care of an entirely new character of business in a new way? Must provision be made for a joint use of the terminal by train on the one hand and for an extension of the train service by motor coach on the other hand?

C. W. Baldridge (A. T. & S. F.): People can travel upon only one train at a time and can go to an individual station just as easily as to a joint terminal, except, of course, as to the question of the advantage of location; therefore, the benefit of a joint terminal, if there is any, goes entirely to the outsider who wishes to go through the town without a stop. Being able to change from one train to another in the same station may be a benefit to the traveler or it may not be, depending somewhat upon the size and arrangement of the station.

Consider the case of a certain Union Station in a middle western city, one that claims the greatest amount of changing of trains in the world. The traveler who must change cars there is required to spend a good ten minutes of walking and climbing, from which there is no escape. This is not much better than taking a taxicab or a transfer bus to another station. In a great many cases a joint terminal must be so located that many, and sometimes all, trains entering it lose considerable time in getting to and from it. This loss of time affects not only the transferring traveler, who may be getting some benefit out of a joint station, but it affects all other travelers on the train who are receiving no compensating advantages.

When all things are considered, the margin of benefit to the public in general from a joint passenger terminal is not likely to be very great, if there is any, and it is strange that people living in any town should clamor for a joint passenger station in their own town.

In cities where practically all passengers stop for a few hours or more, there is no justification for a joint terminal unless such a terminal can be made to produce an actual economy for the railroads and through them to the public. To a large extent, each joint terminal proposition must be studied as an individual problem.

[The report on the Joint Use of Passenger Terminals was accepted as information.]

[Appendix B—Scales was accepted as information.]

[Appendix C—Freight Yard Design was presented by the sub-committee chairman J. E. Armstrong (C. P.) as a progress report.]

R. H. Ford (C. R. I. & P.): There is nothing that will add so much to the benefit of the committee on either design or operation as a complete time study for a period of ten days, or thereabouts, taking in every operation going on in that yard.

G. D. Brooke (C. & O.): I suggest that the relation of road facilities to the terminal facilities is a very important matter in connection with this study of the need for terminals.

R. B. Jones (C. P.): The second of the introductory paragraphs, outlining the general conditions under which an additional yard is justified, does not, I believe, put sufficient stress on the inadvisability of

duplicating existing yards. This paragraph would be improved by substituting for the last sentence "an additional yard is wanted only when it can be shown that the existing yard can not be made large enough to handle the immediately prospective traffic, and that a new yard large enough to handle all the traffic and so permit of abandoning of the existing yard can not be economically provided." The clause dealing with length of receiving and departure tracks is not entirely clear. Is it the thought of the committee that all tracks receiving or used for departure should be long enough to handle the maximum freight?

Chairman Armstrong: It is a very exceptional case, for any existing yard to be abandoned because of the building of a new yard to replace it on account of capacity. Usually when a yard is outgrown, a new yard is built to take a certain portion of the traffic from that yard.

[The report was received as information.]

[Appendix D—Car Retarders in Hump Yards—was presented by O. Gersbach (C. J. R.)].

E. R. Lewis (M. C.): I believe that any one who has studied the subject at all would recommend that hump yards built in the future be built to a profile which is suitable for car retarders, with the idea of installing them if so decided, with the least expense. There are many yards in the country now, probably most of them not built to the profile that is absolutely suitable for the car retarder as we know it now, and a good many alterations are necessary if they are to be installed. There is the possibility that car retarders might help a great deal in the future operation of ore dock facilities.

[The report was accepted as information and the committee was dismissed with the thanks of the Association.]

Report on Uniform General Contract Forms

The Committee on Uniform General Contract Forms submitted as final drafts for adoption by the association, forms of agreement for the purchase of electric power; for the joint use of station facilities; for the joint use of poles on railway rights-of-way; and for the furnishing of water from railway water systems to employees and others. It submitted as a tentative draft for information and discussion, a form of contract for the purchase of water. It expressed its belief that there is no occasion for the adoption of a form of maintenance bond, or of a form of agreement for furnishing and boarding men and recommended that these forms be eliminated from the committee's work. W. D. Faucette has been chairman of this committee for six years and a committee member for the last 10 years.

W. D. Faucette
Chairman

FORMS were submitted by the committee covering the following subjects: Agreement for the Purchase of Electrical Energy; Agreement for Joint Use of Freight Station Facilities; Agreement for the Use of Poles on Railway Rights of Way; Agreement for Furnishing Water from Railway Water Systems to Employees and others, and a Contract for the Purchase of Water. With the exception of that covering the purchase of water, these forms were submitted as final drafts for adoption. The last named was submitted as a tentative draft for discussion.

In addition to the committee's work on these matters, the committee chairman was a delegate of the American Railway Engineering Association to the Joint Conference on Standard Construction Contracts, assisted by the vice-chairman. There have been several drafts of the proposed Standard Contract for Construction, finally resulting in a first edition, February, 1925, issued by the Joint Conference. In compliance with the wishes of the American Railway Engineering Association, the name of this association, together with all the other delegates, was omitted from the report. This was done on the theory that the Association did not approve or disapprove this first edition of the standard contract. The president has directed this committee to make a report on this first edition, and this is now under consideration.

The preamble to this first edition was printed in Appendix D in order that members of the Association will be informed as to the basis on which it is issued.

Committee—W. D. Faucette, (S. A. L.), chairman; J. C. Irwin, (B. & A.), vice-chairman; C. Frank Allen, (civil engineer); W. H. Brameld, (Erie), J. B. Carothers, (B. & O.), Clark Dillenbeck (Reading), W. A. Duff (C. & N.), F. H. Fechtig (A. C. L.), B. Herman, (Sou.), F. R. Judd (I. C.), J. S. Lillie, (G. T. W.), O. K. Morgan, (C. C. & O.), F. L. Nicholson (N. S.), C. B. Niehaus (C. of Ga.), H. A. Palmer (C. N.), A. C. Shields (D. & R. S. W.), Charles Silliman, (Pres. Conf. Com.), E. L. Taylor (N. Y. N. H. & H.), C. A. Wilson (Con. Engr.), John Worley (U. of Mich.).

Appendix D—Foreword

AS IT APPEARED IN THE FIRST DRAFT EDITION, STANDARD CONTRACT, OF FEBRUARY, 1925

"As a result of its first two and a half years of work, the Joint Conference, in 1924, submitted to the various national engineering and contracting associations for consideration a tentative standard contract for engineering construction. Through this document, designed as the third tentative draft, discussion was stimulated and opinion crystallized so that the best practice could be formulated.

"Criticism and comments obtained from individuals and associations with respect to the form submitted have necessarily been to some extent hypothetical, as certain principles, incorporated in it, though generally used in building contracts, are not commonly found in engineering practice.

The Conference feels that this criticism and comment should be supplemented by conclusions based upon actual test of the principles. With this idea in mind, it has issued the accompanying First Edition of the Engineering Contract, with such modifications as its deliberations during the past year have shown to be advisable.

"The First Edition is issued by the Conference as an independent body and has not yet been approved by the member associations. Through actual use of this document, which it is hoped the engineering profession will encourage, there will be gained definite knowledge of its serviceability, and such defects as it may contain. This experience, together with the recommendations of the various national organizations, will in due course permit the issuance of revised editions."

Discussion

In the absence of the chairman and vice-chairman of the committee, Clark Dillenbeck (Reading) presented the report on Uniform General Contract Forms.

E. L. Taylor (N. Y. N. H. & H.): Chairman, sub-committee; The sub-committee has collected data and made a study of a Form of Agreement for Furnishing Water from Railway Water Systems to Employees and others. *I move that this form be recommended for adoption.*

C. W. Baldridge (A. T. & S. F.): Paragraph 7 provides that bills for water shall be furnished, and so forth, but it does not provide for any cancellation of the contract in case bills are not paid. It seems there should be some protection there to the company. We should also carry a provision in the form, that the railway company will not be liable for damage for failure to supply water due to causes beyond its control. I should like to ask the committee why they have not given the railway company the same protection as afforded the Water Company in Art. 3, when they are on the other side of the contract.

Chairman Taylor: With respect to your first question that we should provide for termination if the bills were not paid, it was thought this contract would not be used except in relatively unimportant situations where the railroad was merely giving the water service as an accommodation to employees or to some neighbor. It seems to us that Section 11 does protect the railroad company for failure to supply.

Mr. Baldridge: It is impossible to tell when some of the contracts may become very important. I think the committee should consider it further during the coming year.

C. A. Wilson (Consulting Engineer): I was on the committee that handled this contract. It was our belief that those three paragraphs cover every question.

W. H. Woodbury (D. & I. R.): I believe that Mr. Baldridge is exactly right. I move that contract form in which the railroad is to supply water be referred back to the committee. *Motion carried.*

[The second agreement to be used in case the railroad is the purchaser of water, was accepted for discussion.]

Chairman Taylor: The committee also recommends that the proposed form of Maintenance Bond which was assigned as a subject should be withdrawn from the Outline of Work, as our investigation shows there is no general use for such a form.

Chairman Taylor: The committee recommends that the proposed Form of Agreement for Furnishing and Boarding Men be withdrawn from the Outline of Work, as investigation shows that in the localities where there might be use for such a form, the State laws and local requirements are such as would make it impractical to use a general standard form.

[The Form of Agreement for Joint Use of Freight Station Facilities was presented by Chairman Taylor.]

E. B. Craine (C. M. & St. P.): I have a criticism on paragraph 6 with regard to the inclusion of the words "or improvement" in the first line and the neglect to specify in addition the betterment such as you have specified on the maintenance.

Chairman Taylor: We should accept that change.

H. C. Crowell (Penna.): Should not the committee chairman have added to the words "to capital account" after the word "commission" as has been read?

Chairman Taylor: We accept that change.

H. C. Crowell: If it is not too late I would like to go back to paragraph "B" on page 442. After the word "and," would it not be well to insert "other items chargeable under the current rules to the general account, maintenance of way and structures"? In other words there are items that are purely maintenance items. For example, there is depreciation and the expense end of betterments, all of which I assume should be divided in the same way as maintenance items.

President Fairbairn: I would suggest, Mr. Crowell, that you move that this form of agreement be referred back to the committee for another year.

G. D. Brooke (C. & O.): It has also been suggested that the use of icing facilities be given consideration. I am sorry that my suggestions came so late, but I think it is due to my having recently handled a contract of this kind where but one thing was dealt with, so I am in a better position to offer the suggestion now than formerly. I am willing now to leave the matter in the hands of the committee.

Chairman Taylor: I am under the impression that those facilities are usually used under a tariff arrangement.

D. J. Brumley (I. C.): The Illinois Central has under consideration a joint terminal in which all the facilities will be pooled and used by the tenant companies, the joint use of freight houses, the freight platforms, the icing station, team track facilities and all the facilities that are usually found in a modern local freight terminal. It occurs to me that the distribution of cost for maintaining and operating the icing station should be considered by the committee.

Mr. Crowell: I move that the form be referred back to the committee. *Motion carried.*

E. L. Taylor, chairman sub-committee, next presented the report, Appendix C, on Form of Agreement for Purchase of Electrical Energy, Form of Agreement for Joint Use of Poles on Railway Rights-of-Way.

E. B. Katte (N. Y. C.): I would like to add that I believe it is a wise provision in eliminating the contract performed limiting it to lighting and minor power contract, there being so few contracts awarded up to the present time for purposes of large volume of power as used in electric traction that it is hardly possible to standardize at the present time.

President Fairbairn: It has been moved that this form of agreement for Purchase of Electrical Energy be approved for use in the Manual. *Motion carried.*

[The committee recommended for adoption the Form of Agreement for Joint Use of Poles on Railway Rights-of-Way. *A motion to this effect was carried* and the committee was excused with the thanks of the Association.]

Report on Signs, Fences and Crossings

The Committee on Signs, Fences and Crossings presented a report submitting a revision of the standard highway crossing sign and of the standard bridge sign for approval for inclusion in the Manual. It also made some minor changes in the specifications for the construction of bituminous crossings now in the Manual which were presented for approval. It presented a final report on the elimination of highway grade crossings and progress reports on improved methods of preventing corrosion of fence wire, and on the use of natural rock asphalt as a substitute for plank in highway crossings, the latter report containing a number of illustrations to supplement the text. T. E. Rust has been chairman of this committee for 2 years, and a member of the committee for the last 10 years.

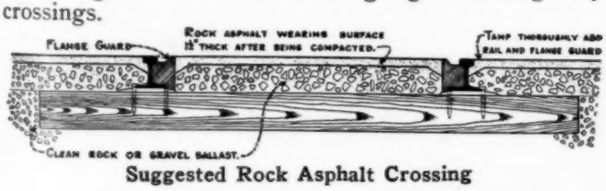
T. E. Rust
Chairman

THE committee presented reports covering the following subjects: Revision of the Manual in Appendix A; methods of apportioning the cost of highway improvements adjacent and parallel to railroad right-of-way in Appendix B; the elimination of highway grade crossings in Appendix C and the use of natural rock asphalt as a substitute for planking in road crossings in Appendix D. The committee recommended that the changes in the Manual in Appendix A be approved.

Committee: T. E. Rust (W. C. F. & N.), Chairman; A. B. Griggs, (A. T. & S. F.), Vice-Chairman; Anton Anderson (C. I. & L.), Maro Johnson (I. C.), F. D. Batchellor (B. & O.), E. R. Lewis (M. C.), J. F. Burns (L. & U.), A. C. Mackenzie (C. P.), R. E. Chamberlain (B. & O.), G. P. Palmer (B. & O. C. T.), C. W. Charleson (C. B. & Q.), H. M. Shepard (Erie), W. E. Colladay (S. C.), C. E. Smith (Con. Engr.), L. B. Curtiss (B. & O. C. T.), W. H. Spiers (D. L. & W.), C. T. Dike (C. & N. W.), T. H. Strate (C. M. & St. P.), G. N. Edmondson (N. Y. C.), W. C. Swartout (M. P.), F. M. Graham (Penna.), M. D. Thompson (I. C.), C. E. Herth (B. & O.), W. J. Towne (C. & N. W.), W. O. Houston (M. C.), A. H. Utter (C. B. & Q.), I. D. Waterman (N. Y., N. H. & H.).

Appendix A—Revision of the Manual

The committee submitted two plans of highway crossing signs, Fig. 1, being a revision of the present plan and to be substituted in place of the standard sign now shown on page 456 of the Manual, and Fig. 2, a new sign for use with warning signals at highway crossings.


FLANGE GUARD
ROCK ASPHALT WEARING SURFACE 1½" THICK AFTER BEING COMPACTED.
TAMP THOROUGHLY ADD RAIL AND FLANGE GUARD
CLEAN ROCK OR GRAVEL BALLAST.

Suggested Rock Asphalt Crossing

It is thought by the committee that the numbering used on the standard bridge sign in the Manual should indicate that the decimal system of numbering bridges should be adopted and that the association should go on record as favoring that method of bridge numbering. Therefore, the committee submitted as Fig 3, a revised plan of a bridge sign showing this system of numbering bridges and recommended the substitution of this sign in the Manual in place of the present sign.

The committee also offered a number of minor revisions embracing corrections in tables of wire gages, nail sizes, barb wire designs, etc., and some changes in the Specifications for Bituminous Crossings. There embodied such changes as the alternate use of gravel rather than crushed stone, and broader provisions as to the type of flangeway.

Appendix B—Methods of Apportioning the Cost of Highway Improvements Adjacent and Parallel to Railroad Rights-of-Way

Under this heading the committee presented statements covering the proportioning of highway costs in 15 states and a table giving a portion of this information for most of the states.

The summary offered is in part as follows:

It is interesting to note at least 40 per cent of the states are now financing their highway improvement or maintenance wholly or partly from a gasoline tax of from 2 cents to 5 cents per gallon; that the construction of improved highways by special assessment is becoming unusual, and that bond issue retired by the gas tax, motor license fees or otherwise are being used by many states. The trend seems to be away from the raising of road funds by ad valorem taxes, a method which is usually more unfair to the railways than any of the others.

Appendix C—Elimination of Highway Grade Crossings

Over-Grade Crossing.—In designing a structure for an over-grade crossing, the kind of traffic to be accommodated is the first consideration. The usual vertical clearance of a highway structure above top of rail of a steam line is 22 ft.; however, in order to obviate the expense of digging the ballast out from under the track in resurfacing it is recommended that the clearance in original construction be made 22.5 ft. to provide for a six-inch raise of the tracks.

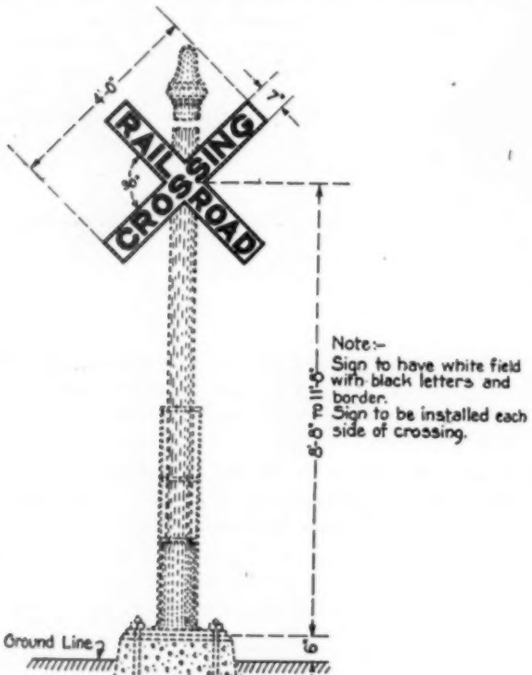
Highway grades and supports on the railroad right-of-way should be preferably so designed that additional railroad tracks may be built without changing the highway structure.

The highway approach grades should not exceed that which prevails in the section of the country for highways of the class under consideration and intersecting grades are to be connected with suitable vertical curves.

The slopes of approach fills are dependent upon the character of the material used. In urban locations the slopes may be sodded, planted or seeded to pre-

vent damage from erosion. In cases of restricted widths of right-of-way for the highway, retaining walls may be necessary, but slopes may be protected by either timber or concrete cribbing made up in suitable dimensions when more economical than retaining walls. Where an elimination is subject to future revision, concrete cribbing may be used, but for permanent work a retaining wall is more suitable.

The kind of roadway paving is determined by the



Sign for Use with Highway Crossing Signal

class and density of traffic, also by the rate of approach grades used. In case of wooden structure, fire protection of asbestos or other suitable material, such as sheet metal, should be placed over each track of the steam road.

Under-Grade Crossings.—An alinement through the subway continuous with that of the highway on either side is in some respects very desirable since it provides a clear view from an approaching vehicle, but the introduction of curves in the highway where necessary, allows the subway to be located at or near right angles to the railroad and thereby reduces the cost of construction. Center columns are sometimes favored since they separate the lines of traffic under the structure and there are conditions where such columns are required on account of extreme length of span. There are often instances when the introduction of columns will materially reduce the cost of elimination due to decreased floor depth necessary.

The committee recommends an overhead clearance of from 12 to 14 ft. On important traffic arteries without trolley tracks an overhead clearance of 13 1-2 ft. may be required, and on important traffic arteries with trolley tracks an overhead clearance of 14 ft. may be required. The increased vertical clearance, however, adds very materially to the costs of grade separation, due to the increased height of abutments and embankments.

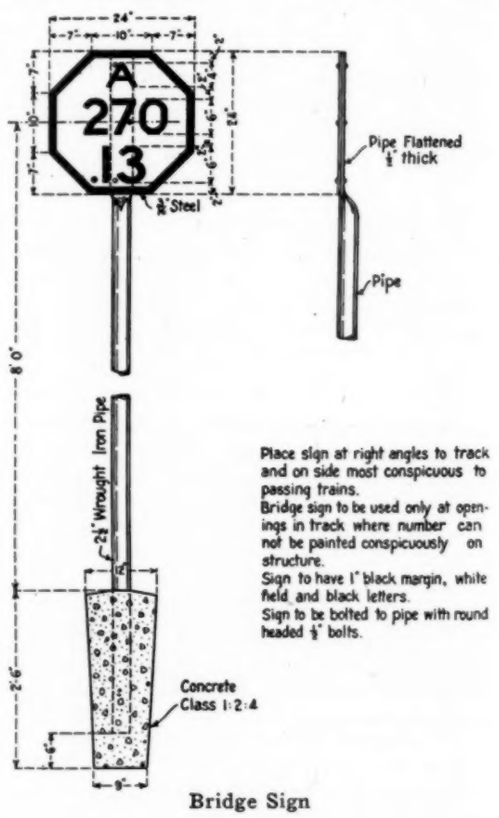
A subway for vehicular traffic only should have a clear roadway width of not less than 18 ft. to provide for two lines of traffic. This minimum width should be increased in multiples of 9 ft. for each additional line of traffic for which provision is to be made. Where sidewalks are to be provided on one or both sides they may be raised above the roadway level to a minimum overhead clearance of 8 ft.

The same principles apply to the approach of undergrade and over-grade crossings. The grades should be designed so as to allow for future tracks. If an important intersecting street is crossed by a heavy approach grade it is considered good practice to reduce the approach grade to about two per cent for the width of the intersecting street to provide for a safe traffic movement.

Construction Methods.—(Under this head a brief outline was offered covering some of the methods followed in handling the work.)

Appendix D—Improved Methods of Preventing Corrosion of Fence Wire

The committee found that the average life of wire on 38 roads is 16 years. The average effective life of the galvanizing on 24 of them is 10 years. The life of


24"
7"
10"
7"
A
270
.13
Pipe Flattened ½" thick
½" Steel
Pipe
8'-0"
2½" Wrought Iron Pipe
Place sign at right angles to track and on side most conspicuous to passing trains.
Bridge sign to be used only at openings in track where number can not be painted conspicuously on structure.
Sign to have 1" black margin, white field and black letters.
Sign to be bolted to pipe with round headed ½" bolts.
2'-6"
Concrete Class 1:2:4
9"

Bridge Sign

the wire as reported varies from about 5 years along the Gulf coast and 6 years in mill districts, to 40 years in the desert regions of the Southwest. In general, longer life is reported on roads in the West and Central West than on those along the coast or serving industrial territory. Proximity to the sea coast, coal mines, and industrial plants, nearness to the track, locations in swamps and wooded country, frequent burning of waylands, heavy snows, abuse by tres-

passers, and damage by live stock, are given as conditions which affect the life of the fence adversely.

One-third of the roads reporting use the Preece test for galvanizing as given in the Manual; the others order fencing by trade names and rely on the manufacturers' representations as to quality. One road reports the use of 0.15 to 0.25 per cent of copper in the steel from which the wire is drawn, and several are making tests of lead coated wire.

The committee now has two representatives on an A. S. T. M. sub-committee which is making tests on wire.

Test fences are being erected at Pittsburgh, Pa.; State College, Pa.; Altoona, Pa.; Sandy Hook, N. Y., and Key West, Fla. Wire with and without copper content with various weights of coating applied by several processes is to be tested. All fencing is to be attached to concrete posts, and it is hoped to have it all erected by July 1, 1926. It will be of interest to note in this connection that the Pennsylvania and New York Central have given material assistance in carrying out these tests.

Appendix E—Natural Rock Asphalt as a Substitute for Plank in Road Crossings

Natural rock asphalt so-called consists of sandstone or limestone rocks that have been saturated or impregnated with bituminous material, this being the residue remaining from the evaporation of petroleum formerly carried which was of paraffin or semi-paraffin base. The extent of evaporation and character of petroleum as well as the character of the rock saturated by the petroleum cause wide variation in the percentages of bituminous material found in different localities.

At the present time commercial production of natural rock asphalts for paving purposes is confined in this country to five states—Kentucky, Texas, Oklahoma, California and Alabama. Of the 1923 output, Kentucky produced 46 per cent, Texas 37 per cent, most of the remainder coming from Oklahoma.

The process of manufacture consists of crushing the natural sandstone or limestone rock to the desired degree of fineness to permit compacting when subsequently laid and rolled. It has been found that each particle or granule of the original rock is fully coated with bitumen. The percentage of bitumen varies widely in different quarries and even in the same quarry, so that blending is frequently necessary to produce the desired percentages. Some producers use asphalt from outside sources to bring up the percentage of bitumen to the desired amount.

Present practice indicates that the following specifications for natural rock asphalt are suitable for railroad crossings:

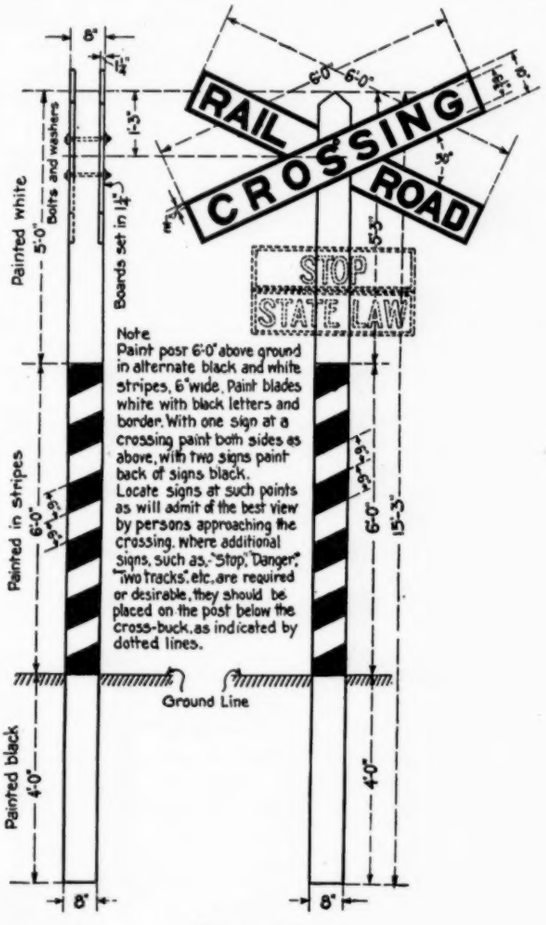
Natural Rock Asphalt.—Natural rock asphalt should contain an average of not less than 6½ per cent nor more than 9 per cent of natural bitumen. Rock shall be thoroughly ground and when delivered shall contain not more than 5 per cent of unground material; and none of the 5 per cent of unground material shall contain pieces larged than ¾ in. in diameter.

Test of Natural Rock Asphalt for Bitumen.—To test the natural rock asphalt for total bitumen, five samples shall be taken from different parts of the car (approximately one pound in all), which shall be thoroughly mixed. From this a test sample shall be taken and weighed and the bitumen then removed by burning. The residue shall then be weighed, the difference in weight representing the total amount of bitumen.

Natural rock asphalt crossings have been used by various railroads for some time. A suggested cross-section of a natural rock asphalt crossing is given in the drawing.

Information as to the cost of natural rock asphalt crossings, gathered from different railroads, shows that the cost above top of ties and exclusive of flange guards, ranges from 13.4 cents per square foot to 35.5 cents per square foot, the majority of the crossings costing between 15.5 cents and 23 cents per square foot. The cost of plank crossings, gathered in the same manner, ranges from 16 cents to 77.2 cents per square foot, the majority costing 35 cents. Crossings placed in accordance with the specifications adopted last year should give good results, but clean gravel may be substituted where rock is mentioned in these specifications and satisfactory results obtained.

From the crossings which have been examined we believe some kind of flange guard should be used to give the best results. In our opinion, natural rock


RAIL
CROSSING
ROAD
STOP
STATE LAW
Painted white
Boards set in 1½"
Bolts and washers
Painted in stripes
Painted black
Ground Line
Note
Paint post 6'-0" above ground in alternate black and white stripes, 6" wide. Paint blades white with black letters and border. With one sign at a crossing paint both sides as above, with two signs paint back of signs black. Locate signs at such points as will admit of the best view by persons approaching the crossing. Where additional signs, such as, "Stop," "Danger," "Two tracks," etc., are required or desirable, they should be placed on the post below the cross-buck, as indicated by dotted lines.

Crossing Sign

asphalt, properly installed, will make a better highway crossing than plank for the following reasons:

1. The first cost is less where transportation charges are not excessive.
2. The cost of maintenance is less.
3. There is no danger of equipment being damaged from picking up plank.
4. It provides better drainage protection for tracks.
5. It does not deteriorate in stock.

Discussion

[The report was introduced by T. E. Rust (W. C. F. & N.), chairman. Sub-committee chairman G. N. Edmondson (N. Y. C.), presented the report on the Revision of the Highway Crossing Sign with a motion that the two signs recommended be adopted for publication in the Manual.]

C. W. Baldridge (A. T. & S. F.): Automobiles are struck on crossings frequently where they have darted out from behind one train into the path of another on an adjoining track. It seems to me that our crossing signs should carry a board between the cross buck sign and the stop state law board, on which should be shown the number of tracks to be crossed at that place.

Chairman Edmondson: There is a place in the notes to specify additional signs for two tracks. I assume that covered the situation where necessary.

Mr. Baldridge: It is all very well to state that there is a place there for additional signs but I believe we should go on record recommending that all our crossing signs show the number of tracks that are to be crossed. I move that the question of placing additional space on our crossing sign posts on which is to be shown the number of tracks to be crossed be referred to this committee for a report for or against at next year's convention. *The motion carried.*

President Fairbairn: Mr. Baldridge, it is not your intention to hold this up.

Mr. Baldridge: Simply to refer that question to this committee for next year's consideration with instructions to bring in a report next year for or against it.

[*The motion for the adoption of the report was carried.*]

A. H. Rudd (Penna.): The special committee on Highway Crossing Protection of the Signal section instructed me that if this four-foot cross-buck were adopted I should present their thanks to this Association for having acceded to our wishes after two or three years fight.

Chairman Edmondson: I move that the revision of the bridge sign adopting the decimal method of numbering bridges be adopted and published in the Manual. *The motion carried.*

Chairman Edmondson: I move that the tables including dimensions for nails and fence wire be adopted and published in the Manual, also the corrections made of what is now shown in that Manual. *Motion carried.*

Chairman Edmondson: I move that these changes in the specifications for the construction of bituminous crossings be adopted and substituted in the manual for the present information. *Motion carried.*

[The report on Methods of Apportioning the Cost of Highway Improvements adjacent and parallel to Railroad Rights-of-Way was accepted as information.]

[The report on Elimination of Highway Grade Crossings was accepted as information.]

[The report on Improved Methods of Preventing Corrosion of Fence Wire was accepted as information.]

[The report on The Use of Natural Rock Asphalt as a Substitute for Plank in Road Crossings was presented by a member of the sub-committee, F. D. Batchellor (B. & O.)]

J. L. Campbell (S. P.): I would like to ask the committee if they think that asphalt will stand up against the rail without breaking up.

Mr. Batchellor: No, we think that there should be a flangeway, and if you notice in the cross section which we have presented, we have shown an additional thickness of the rock asphalt around the rail, it being our idea that this would take care of part of the vibration caused by the rail, but we believe that a flangeway should be used.

[This report was accepted as information.]

President Fairbairn: Mr. Rudd has brought to my attention that the Illinois Commerce Commission on Highway Crossing Protection has just issued an order under date of February 23, which conforms to the standards that we have just adopted as proposed by the Committee on Highway Crossings and Fences.

[The committee was excused with the thanks of the Association.]

Report of the Committee on Masonry

The Committee on Masonry submitted a progress report on the report of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete. The committee reviewed the report of the joint committee which appeared in Bulletin 269, September, 1924, and recommended a number of changes in various sections of that report. Appended to the committee's report was a discussion of the section on design of concrete columns in the joint committee's report, by T. L. Condron, and comments on the joint committee's recommendations for flat slabs. The committee recommended that its report be transmitted through the proper channels to the joint committee. C. C. Westfall has been chairman of the committee for 4 years and a member of it for the last 7 years.

C. C. Westfall
Chairman

THIS committee confined its report to a review of the Report of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete and recommended that its report be accepted as information and that a copy be transmitted through the proper channels to the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete.

Committee: C. C. Westfall (I. C.), Chairman; Job Tuthill (P. M.), Vice-Chairman; J. T. Andrews (B. & O.), R. Armour (C. N. R.), G. E. Boyd (Railway Review), H. M. Brown (F. E. C.), T. L. Condron (Cons. Engr.), B. W. Guppy (B. & M.), J. L. Harrington (Cons. Engr.), M. Hirschthal (D. L. & W.), L. H. Hornsby (S. A. L.), W. S. Lacher (Railway Age), A. N. Laird (G. T.), J. A. Lahmer (M. P.), H. C. Libby (Sou.), J. L. Miller (N. Y. C.), R. E. Miller (St. L. S. F.), C. P. Richardson (C. R. I. & P.), F. E. Schall (L. V.), L. W. Skov (C. B. & Q.), A. W. Smith (C. N. R.), G. E. Tebbetts (Chi. Rap. Trans.), J. J. Yates (C. R. R.-F. N. S.).

Appendix A—Report on the Report of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete.

The Masonry committee was charged with the review of the report. The committee has not attempted in its report to comment upon every part of the specifications, but has called attention to those sections wherein the committee differs with the specifications. It recommends to the members of the association, therefore, that in making use of the Joint Committee's specifications, they give consideration to the modifications herein presented.

The comments are in part as follows:

Definitions

ENGINEER—The committee recommends the definition of "Engineer" should read: "The engineer in responsible charge of the work *for the owner.*"

"SLUMP"—The committee recommends the substitution of the word "Subsidence" for *"Shortening,"* the definition to read: "SLUMP—The subsidence of a standard test mass of freshly mixed concrete used as a measure of workability in accordance with the standard method."

Paragraph 13: The committee recommends that "Slag" described in the A. R. E. A. specifications be included in coarse aggregate permitted in the use of concrete.

Paragraph 21: METAL REINFORCEMENT—The present specifications of the A. R. E. A. do not permit twisted bars and do not permit rail steel bars. The committee recommends that the A. R. E. A. specifications be followed.

In Table 5, under paragraph 29, the committee recommends the omission of the word "Vertical" in line (a) and all of line (c). This would provide for the same slump for thin sections and columns regardless of whether the thin sections were vertical or horizontal and would limit the maximum slump to six inches.

The committee also recommends in connection with Table 5 and Paragraph 30 that consideration should be given to the use of the flow table as a measure of workability of concrete as the present specifications refer only to the slump test.

Paragraph 76: WATER-TIGHT CONSTRUCTION JOINTS—The committee recommends for water-tight construction joints the use of sheet lead, sheet zinc or other metal not less than 6 in. wide and extended the full length of the joint and embedded equally in the two deposits of concrete. The Joint Committee report does not provide for the use of metal in such joint.

Section 83: This section covers the depositing of concrete in sea water. The committee recommends that the third sentence be changed to read: "The placing of concrete from *two feet below water to two feet above high water," shall be a continuous operation,* substituting the words shown in italics for the words "between tides."

Section 84: The committee recommends changing the words "at least" in the first and second line to "not less than," and recommends changing the third sentence to read: "Where severe climatic conditions or severe abrasions are anticipated, the face of the concrete from two feet below low water to two feet above high water, or from a plane below to a plane above wave action shall be protected by stone of suitable quality or dense vitrified shale brick as designated on the plans or as required by the Engineer, or in special cases the protection may be creosoted timber." This change adds the words "severe climatic conditions" in the first part of the sentence and lays less stress on the protection by means of creosoted timber than is done in the Joint Committee report.

Chapter 10: SURFACE FINISH.—The section on surface finish will be materially improved by combining with it some of the material in the A. R. E. A. Mannual. Such additions, together with changes recommended in the Joint Committee report are as follows:

(The committee offered a complete section on this subject, which is omitted here).

Design of Rectangular Beams and Slabs

Paragraph 106: This section determines the span length of beams and slabs where brackets are provided, but states that no portion of such brackets should be considered as adding to the effective depth of the beam. The committee questions whether it is proper to neglect the area added by the bracket in such case in considering the design of the beam.

Section 112 reads: "The distance between lateral supports of the compression area of a beam shall not exceed 24 times the least width of compression flange."

The committee recommends that a sliding value of allowable stresses should be provided by a formula which would require a reduction in the allowable stress as the slenderness ratio increases and a suggested formula is

$$1.20—L/50b.$$

Section 119: It is recommended that provision for reducing the allowable compressive stress be made in the case of isolated T-beams as suggested in the same manner as Paragraph 112 for plain beams.

Paragraph 125: The sentence reads: "Stirrups or bent-up bars which are not anchored at both ends according to provisions of Section 141 shall not be considered as effective as web reinforcement." It is recommended that this be changed to read: "Stirrups or bent-up bars to be considered as web reinforcement must be anchored at both ends in accordance with provisions of section 141."

Paragraph 128: It is recommended that the last clause be changed to read "In no case shall the shearing unit stress exceed .075 f_c'."

Flat Slabs and Columns

The recommendations of the Joint Committee for the designing of flat slabs are formulated for structures that carry uniformly distributed loads, such as occur in buildings.

The Masonry committee does not approve these recommendations for the design of flat slabs is not prepared at this time to make any other definite recommendations regarding this feature of the Joint Committee report. The committee, however, does submit for information a discussion of this subject, offered by one of its members, which it is felt will be helpful to engineers studying the subject of flat slab design (omitted here), and suggests also a consideration of the rules adopted by the Department of Buildings of the City of Chicago, which have been used widely by designers.

COLUMNS: The committee does not approve of the recommendations of the Joint Committee on the design of reinforced concrete columns, but it is not now prepared to make other recomendations. There is presented, however, a discussion of this section by one of the members of the committee which it is believed will throw some light upon the subject in so far as making a comparison between the Joint Committee's recommendations and other formulæ which are in use (omitted here).

Paragraph 160: The committee recommends that the limiting length of reinforced concrete columns be taken as 15 times the diameter or least side of the column instead of 40 times the least radius of gyration.

Paragraph 164: It is recommended that the minimum protection over the reinforcement of all columns be 1½ in. instead of 1½ in. in square columns or 2 in. in round or octagonal columns.

Paragraph 166: It is recommended that this be changed as follows:

"Where the *reinforcement is figured to carry stress,* lateral ties shall be not less than ¼ in. in diameter, spaced not more than 8 in. apart.

Paragraph 167: It is recommended that the last paragraph be given the heading (c).

Paragraph 170: It is recommended that this paragraph be changed in order to conform to the use of the expression 15*D* as the limiting length of a column instead of 40*R*, formula 47, thus reading:

$$\frac{P'}{P} = 1.5 - \frac{h}{30D}$$

where D = diameter or least side of the column.

Paragraph 173: It is recommended that this paragraph be changed to read:

"The load per unit of area on soil footings shall be computed by dividing the total load on the footing by the area of the base, giving proper consideration to eccentricity."

The original paragraph neglects the weight of the footing and also neglects eccentricity.

Paragraph 176: It is recommended that the words *"except where there is eccentric loading"* be added to the last clause of the first paragraph.

Paragraph 182: It is recommended that Formula 49 be omitted and that the sentence immediately above the formula be changed to read as follows:

"Permissible unit stress on top of the pedestal or footing directly under the column base shall be not greater than

$$.35f$$

the minimum distance from the edge of the column base to the edge of the top of the footing being 3 in., and the area of the top of the pedestal being at least twice the area of the column base."

Summary of Working Stresses

Paragraph 187 (a): Change 40*R* to 15*D* so that this line will read *"Columns whose length does not exceed* 15*D* where *D* equals the diameter or least side of the column."

Extreme Fiber Stress in Flexure

Paragraph 188: The committee recommends

$$.325f_c' \text{ instead of } .4f_c'$$

Extreme fiber stress in flexure adjacent to supports of continuous beams: The committee recommends
$.375f_c'$ instead of $.45f_c'$

Paragraph 189: Change to read: "Tension in concrete (a) in reinforced concrete members, None. (b) In plain concrete $.025f_c'$."

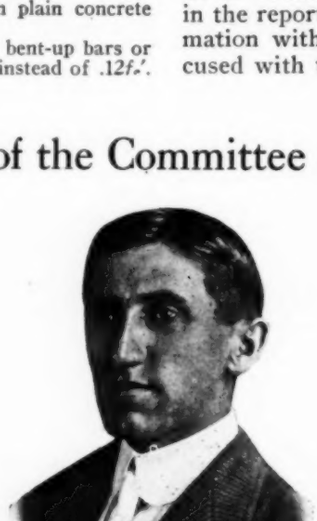
Paragraph 191: (b) Beams with stirrups or bent-up bars or a combination of the two; shearing stress $.075f_c'$ instead of $.12f_c'$.

Discussion

[The report of the committee was presented by C. C. Westfall (I. C.) who explained several details in the report. The report was then accepted as information without discussion. The committee was excused with the thanks of the Association.]

Report of the Committee on Track

The Committee on Track has carried on the laborious and exacting work in successive years of preparing plans and sepcifications for various track materials and accessories. Responsive to the continuing importance of this work the committee presented this year an extensive revision of the Manual, involving proposed revised specifications for steel tie plates and soft steel cut track spikes. It also presented for inclusion in the Manual detailed plans of switches and frogs prepared in conference with the Manganese Track Society. Data on the effect of brine drippings on track appliances was submitted. Canting of rail inward and taper of tread of wheels was also included in the report. J. V. Neubert, concluding his first year as chairman, has been a member for 10 years.



J. V. Neubert
Chairman

THE committee presented reports as follows: (1) Revision of Manual (Appendix A). (2) Detail plans of switches, frogs and crossings, including plans of self-guarded frogs (Appendix B). (3) Specifications and design of wooden handles for track tools (Appendix C). (4) Effect of brine drippings on track appliances and tests of tie plates subject to brine drippings (Appendix D). (5) Canting of rail inward and taper of tread of wheels (Appendix E). (6) Methods of determining recommendations for rail renewals (Appendix F). (7) Plans for tie plates (Appendix G). (8) Cause and prevention of rail battering; principles of rail joint design (Appendix H). (9) Track construction in paved streets; specifications for girder rails (Appendix I). (10) Use of nutlocks for rail joints, with special reference to heat treated bolts of large diameter (Appendix J).

It recommended: (1) That the changes in the Manual outlined in Appendix A be approved. (2) That the conclusions in Appendices B, C, G and I be adopted as recommended practice and published in the Manual. (3) That further data as outlined in Appendices B to J, inclusive, be received as information only.

Committee: J. V. Neubert (N. Y. C.), chairman; C. R. Harding (S. P.), vice-chairman; L. B. Allen (C. & O.), V. Angerer (Wm. Wharton, Jr., & Co., Inc.), J. B. Baker (Penna.), S. Balkwill (Balkwill Mang. Crossing Co.), C. W. Breed (C. B. & Q.), H. W. Brown (Penna.), W. G. Brown (F. E. C.), H. G. Clark (C. R. I. & P.), J. W. DeMoyer (A. C.), L. W. Deslauriers (C. P. R.), W. J. Harris (C. B. & Q.), O. F. Harting (T. R. R. A.), T. T. Irving (C. N. R.), H. D. Knecht (M. P.), E. R. Lewis (M. C.), R. L. Longshore (Wabash), J. deN. Macomb (A. T. & S. F.), F. H. Masters (E. J. & E.), S. B. McConnell (C. P. R.), C. E. Merwin (D. T.), W. W. Morrison (P. & S.), J. B. Myers (B. & O.), W. G. Nusz (I. C.), J. B. Latimer (C. B. & Q.), G. A. Peabody (Cleveland Frog & Sw. Co.), W. H. Petersen (C. R. I. & P.), I. H. Schram (Erie), G. J. Slibeck (Pettibone Mulliken Co.), J. B. Strong (Ramabo Ajax), E. D. Swift (B. Ry. of C.), J. R. Watt (L. & N.), W. P. Wiltsee (N. & W.).

Appendix A—Revision of Manual

The committee recommended the following changes in the Manual and to adopted plans:

Revise specifications for Switches, Frogs, Crossings and Guard Rails, adopted March, 1921, printed on pages 214-220, 1921 Manual, as follows:

Add to Section 14 (Bolts) the following paragraph:
"Bolts with countersunk heads, button heads or cone heads shall be provided with locking necks or other effective locking means to keep bolts from turning."

Change Section 24, reading "Nut Locks. Nut locks shall be of good strong spring steel," to read:

"24. Spring Washers. For heat treated or high tensile bolts, spring washers shown on trackwork plans shall conform to specifications of the American Railway Engineering Association for high spring pressure and where nutlocks (N.L.) are specified on present trackwork plans the term 'spring washers' shall be understood."

Revise Plan No. 773, adopted March, 1925, Solid Manganese Steel Crossings, Angles below 40 deg. to 30 deg., inclusive, to specify in title instead of angles as given the following angles:

"Angles below 40 deg. to 25 deg., inclusive."

EXPLANATION: This change is recommended as detail of construction illustrated on this plan, it has been decided, will apply and is recommended for angles down to and including 25 deg. For plans of solid manganese crossings covering smaller angles, see Appendix B.

Omit specifications for Steel Tie Plates, printed in the 1921 Manual, beginning on page 203, and substitute the following specifications:

PROPOSED REVISED SPECIFICATIONS FOR STEEL TIE PLATES

The committee presented revised specifications for steel tie plates with the recommendation that they be substituted for the specifications now in the Manual. Aside from certain changes in diction the following changes were made: Under Chemical Properties and Tests provision is made for three analyses every 24

hours, representing the average of the elements carbon and phosphorus contained in the steel, one for each 8-hour turn, to accord with the present mill practice of working three turns per 24 hours, and the provision for the determination of the percentages of manganese and sulphur is eliminated; under Physical Properties and Tests the present A. R. E. A. tension tests are eliminated; under Workmanship and Finish, the tolerance for tie plates with shoulders perpendicular to the direction of rolling is revised to read 3/16 in. in thickness instead of ⅛ in. in the present specifications; and the shipment clause in the present specifications is omitted.

Proposed Revised Specifications for Soft Steel Cut Track Spikes

The committee presented revised specifications for soft steel cut track spikes with the recommendation that they be substituted for the specifications now in the Manual. The following changes were made: Under Chemical Properties and Tests, the carbon content is changed to read not under 0.06 per cent for Bessemer steel and not under 0.12 per cent for open hearth steel; provision is made for a carbon determination for each melt of Bessemer steel and for three determinations every 24 hours, one for each 8-hour turn, representing the average carbon content in the steel; the determination of the elements manganese, phosphorus and sulphur is omitted for both Bessemer and open hearth steel; under Physical Properties and Tests, revision is made specifying that one bend test shall be made from each lot of five tons or fraction thereof; and the shipment clause in the present specifications is omitted.

Appendix B—Detail Plans of Switches, Frogs and Crossings, Including Plans of Self-Guarded Frogs

The plans and specifications presented in this appendix and the revisions to the Manual in Appendix A coming under this subject have been prepared in conference with the Standardization Committee of the Manganese Track Society.

"A"—Crossings, Steam Railroad Over Electric Railway

Plan No. 778 of manganese steel insert crossings, steam railroad over electric railway, angles below 45 deg. to 30 deg., inclusive, was offered for adoption as recommended practice.

This plan completes the series of plans of crossings for steam railroad over electric railway. Solid manganese construction for steam railroad over electric railway crossings is recommended for angles 90 to 40 or 45 deg. as per Plans No. 776 and No. 777, adopted March, 1924. Manganese insert construction is recommended for angles below 40 or 45 deg. to 30 deg. as detailed on Plan No. 778 now offered. For bolted rail crossings, steam railroad over electric railway, Plans No. 716 and No. 717 for angles 90 to 30 deg., were adopted March, 1925. The committee recommended that crossings, steam railroad over electric railway, below 30 deg., particularly for narrow tread and shallow flange electric railway car equipment, be avoided.

The committee recommended that the following plans be adopted as recommended practice and printed in the Manual:

Plan No. 778, Manganese Steel Insert Crossings.

Plan No. 213, Details for Split Switch Point Derail.

The committee offered for information to invite criticism the following plans and index sheets:

Plan No. 774, Solid Manganese Steel Crossing.

Plan No. 775, Solid Manganese Steel Crossing.

Plan No. 720, Tie Layout for Crossings.

Plan No. 321, Tie Layout Standard Length Rigid Frogs for One-Piece Guard Rail.

Plan No. 325, Frog Fillers together with specifications.

Index, pages I and II, listing latest plans and specifications.

Index, page III, listing revisions not appearing on plans and specifications, also plans to be offered in March, 1926.

Plan No. 643, No. 8 Solid Manganese Steel Self-Guarded Frog.

Appendix C—Specifications and Design of Hickory Handles for Track Tools

Material

Handles shall be made of sound hickory. The wood shall be coarse grained and show not more than twenty rings of annual growth per inch, and after seasoning, shall weigh not less than 37½ lb. per cubic foot. It shall be straight grained, free from decay, knots, checks, worm holes, dip grain, bird peck or other injurious defect. The wood shall be thoroughly seasoned with a moisture content of not over 15 per cent and not less than 8 per cent.

Physical Requirements

Handles shall be smooth, straight, and for each type of tool, uniform in size and shape. The grain of the wood must run parallel to the center line of the handle, with an allowable variation of not over one in twenty. Handles which are warped or twisted will not be accepted.

Design

Handles shall conform to the dimensions shown on the plan forming part of this specification, with an allowable variation of one-quarter inch in length, and one-sixteenth inch over or one-thirty-second inch under for all other dimensions.

Manufacture

(a) Handles shall be smoothly finished and waxed. Handles finished with a coating of linseed oil instead of wax will be accepted when order so specifies.

(b) Each handle shall be plainly marked for identification as specified by the purchaser, with his initials or brand, burned or stamped with steel stencil, or when so ordered, marked with black paint. Marking unless otherwise specified by purchaser shall be placed near the hand grasp end of handles and letters must not be less than one-quarter inch in height.

Inspection

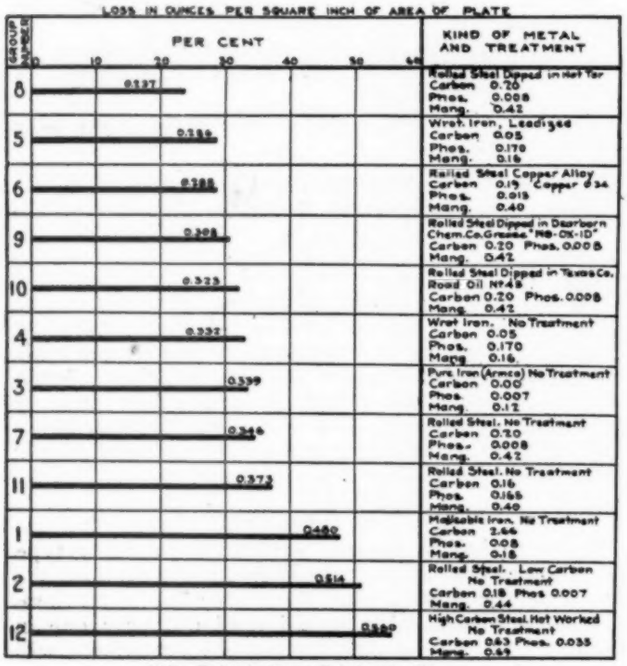
(a) Handles will be inspected at points of manufacture, shipment or destination in suitable and convenient places satisfactory to the purchaser.

(b) Inspectors representing the purchaser shall have free entry to the works of the manufacturer at all times while work on the contract of the purchaser is being performed, and shall have all reasonable facilities afforded them, free of cost, to satisfy them that the handles are being supplied in accordance with these specifications.

(c) Inspectors will make a reasonably close examination of each handle and the acceptance or rejection will be based on the inspector's knowledge of the appearance and weight of wood of the density required; rings of annual growth will not be counted nor handles weighed by scale unless the inspectors' decisions

are questioned. Exactness of size and shape will be checked by accurate measurements of handles taken at random.

(d) Handles which show injurious defects subsequent to their acceptance at the place of manufacture or sale, shall be rejected and shall be replaced by the manufacturer at his own expense.


LOSS IN OUNCES PER SQUARE INCH OF AREA OF PLATE
GROUP NUMBER
PER CENT
0 10 20 30 40 50 60
KIND OF METAL AND TREATMENT
8 0.227 Rolled Steel Dipped in Hot Tar Carbon 0.20 Phos. 0.008 Mang. 0.42
5 0.286 Wrot Iron, Leadless Carbon 0.05 Phos. 0.170 Mang. 0.16
6 0.288 Rolled Steel Copper Alloy Carbon 0.19 Copper 0.24 Phos. 0.013 Mang. 0.40
9 0.298 Rolled Steel Dipped in Dearborn Chem. Co. Grease "NB-OK-ID" Carbon 0.20 Phos. 0.008 Mang. 0.42
10 0.323 Rolled Steel Dipped in Texas Co. Road Oil N°48 Carbon 0.20 Phos. 0.008 Mang. 0.42
4 0.332 Wrot Iron. No Treatment Carbon 0.05 Phos. 0.170 Mang. 0.16
3 0.339 Pure Iron (Armco) No Treatment Carbon 0.00 Phos. 0.007 Mang. 0.12
7 0.346 Rolled Steel. No Treatment Carbon 0.20 Phos. 0.008 Mang. 0.42
11 0.372 Rolled Steel. No Treatment Carbon 0.16 Phos. 0.165 Mang. 0.40
1 0.480 Malleable Iron. No Treatment Carbon 2.66 Phos. 0.08 Mang. 0.18
2 0.514 Rolled Steel. Low Carbon No Treatment Carbon 0.18 Phos 0.007 Mang. 0.44
12 0.580 High Carbon Steel Hot Worked No Treatment Carbon 0.63 Phos. 0.035 Mang. 0.49

Note: Plates in Groups 7, 8, 9 & 10 alike except for treatment.

Results of Tests on the Plates Subjected to Brine Drippings Showing Loss of Weight by Corrosion

Delivery

Accepted handles shall be shipped by the seller in accordance with the instructions in the order covering them; they shall be securely packed in standard packages, each of which shall be marked to show seller's or manufacturer's name and the number and type of the handles contained.

Conclusions

The committee recommends that the plans and specifications offered herewith be adopted as recommended practice and printed in the Manual.

Appendix D—Effect of Brine Drippings on Track Appliances and Tests of Tie Plates Subject to Brine Drippings

The work of the sub-committee has consisted in the installation and observation of test tie plates in certain tracks of the Chicago Junction Railway at the Union Stock Yards, Chicago. The installation was made in the summer of 1921 and the test was terminated in June, 1925, when heavier rail was laid in the tracks. There were twelve groups of these plates, totaling in all approximately 1300 plates. Some of the groups had received coatings or other protective treatment; others were untreated.

An inspection made six months after installation showed that all plates had collected some rust. Inspections were made approximately every six months up to the time of the termination of the test.

Exhibit "A" showing graphically the percentages of loss in weight per ounce per inch of area of 10 plates from each group at the termination of the test. It also gives the important characteristics of the plates.

Exhibit "B" was also offered, consisting of photographs, one of the bottom and one of the top of specimen plates for each group. The plates shown are from the lots of 10 mentioned above and the views were taken before the plates were cleaned.

The committee recommended that this report be received as information.

Appendix E—Canting of Rail Inward and Taper of Tread of Wheel

The Proceedings of the Association, Volume 26, contain a comprehensive discussion of the practices of 67 prominent railways relating to the canting of rail. To arrive at definite conclusions as to the desirability of this practice, reference was made to this report in a letter addressed to the chief engineers of the 47 largest railroads in the United States and Canada. They were asked to give their personal opinion as to whether or not canting of rail was favored, and if favorable, the reasons leading to that conclusion, and similarly if not favorable, the reasons therefor.

Conclusions

1. The summary shows that 6 railroads, with a mileage of 37,664 or 16.7 per cent, are emphatically favorable to the canting of rail; 31 railroads, with a mileage of 129,151 or 57.3 per cent, are favorable; 7 railroads, with a mileage of 51,160 or 22.7 per cent, are unfavorable; and 3 railroads, with a mileage of 7,339 or 3.3 per cent, express an unformed opinion. Further summarized, 74.0 per cent of the mileage addressed favor the canting of rail; 22.7 per cent do not favor; and 3.3 per cent have an unformed opinion.

2. The practice of canting rail is gaining favor, and practically all railroads following this practice indicate that it reduces maintenance, provides a better bearing on the rail and a more uniform wear.

3. No special provisions through switches are necessary when canting rail except to bring rails gradually to a vertical position by adzing.

4. Practice differs as to the amount of cant, the preponderance of replies indicating either 1 in 20 or 1 in 40.

The recommendations of the Committee on Track are:

(1) That rail should be canted inwardly.

(2) That inclined tie plates should be used to produce the desired result.

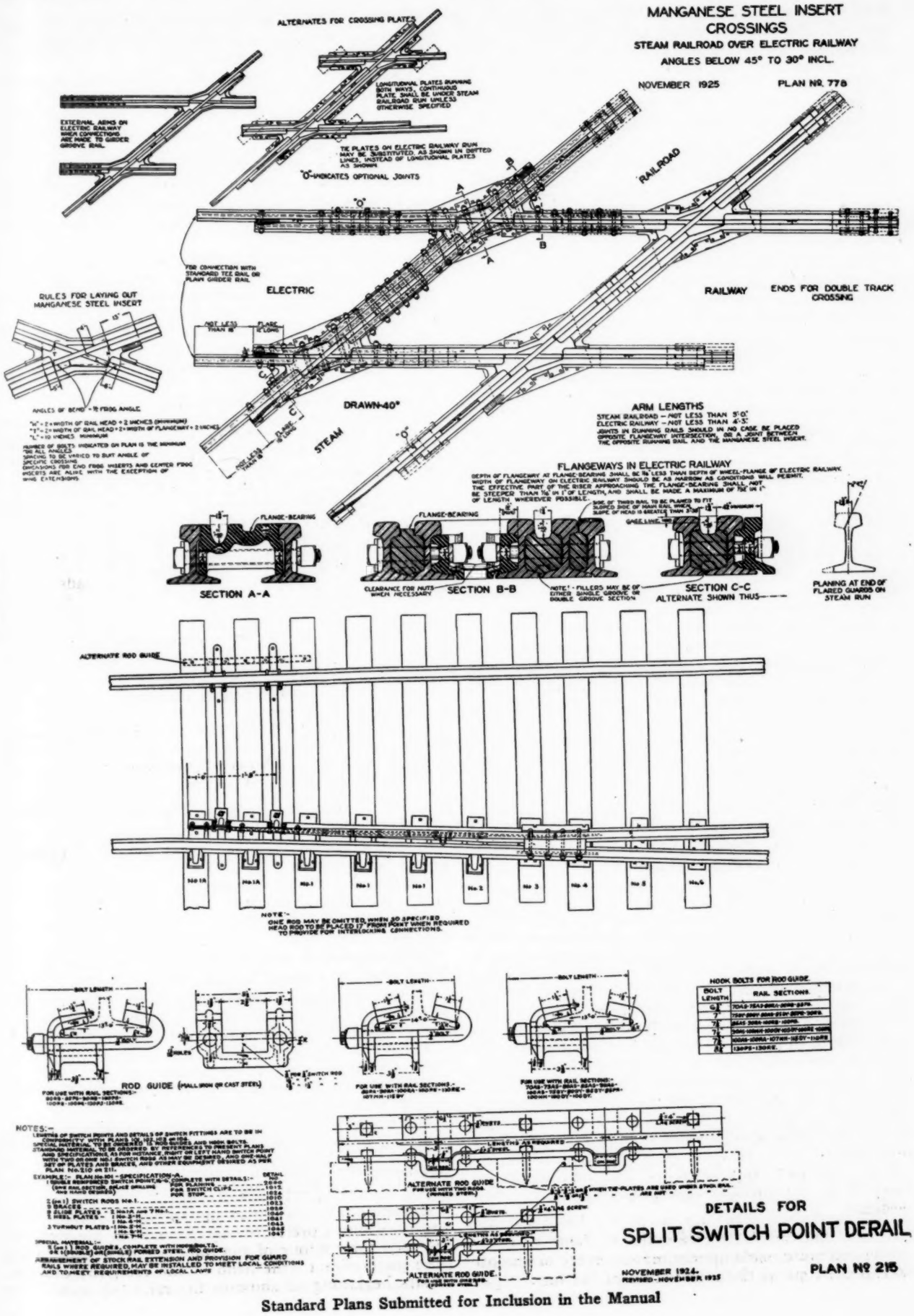
(3) That the amount of cant should be left to the individual railroads.

(4) That these recommendations be printed in the Manual as its final report.

Appendix F—Methods of Determining Recommendations for Rail Renewals

The committee recommended that the following items should be considered:

Track Inspection—Inspection of rail in track should be made, the track being gone over on a motor car at a very moderate speed, and the following conditions noted: (1) The amount of wear of rail should be determined preferably by the use of an instrument to take the contour of the rail; (2) wear spots along the gage edge of the head of the rail; (3) defective spots beginning to show in the rail; (4) driver burn


MANGANESE STEEL INSERT CROSSINGS
STEAM RAILROAD OVER ELECTRIC RAILWAY
ANGLES BELOW 45° TO 30° INCL.
NOVEMBER 1925
PLAN NR. 778
ALTERNATES FOR CROSSING PLATES
LONGITUDINAL PLATES RUNNING BOTH WAYS, CONTINUOUS PLATE SHALL BE UNDER STEAM RAILROAD RUN UNLESS OTHERWISE SPECIFIED
EXTERNAL ARMS ON ELECTRIC RAILWAY WHERE CONNECTIONS ARE MADE TO GIRDER GROOVE RAIL
TIE PLATES ON ELECTRIC RAILWAY RUN MAY BE SUBSTITUTED, AS SHOWN IN DOTTED LINES, INSTEAD OF LONGITUDINAL PLATES AS SHOWN
"O" INDICATES OPTIONAL JOINTS
RAILROAD
TEE CONNECTION WITH STANDARD TEE RAIL OR PLAIN GIRDER RAIL
ELECTRIC
RAILWAY
ENDS FOR DOUBLE TRACK CROSSING
RULES FOR LAYING OUT MANGANESE STEEL INSERT
DRAWN-40°
STEAM
ARM LENGTHS
STEAM RAILROAD — NOT LESS THAN 5'-0"
ELECTRIC RAILWAY — NOT LESS THAN 4'-5"
JOINTS IN GUARDING RAILS SHOULD IN NO CASE BE PLACED OPPOSITE FLANGEWAY INTERSECTION, OR A JOINT BETWEEN THE OPPOSITE RUNNING RAIL AND THE MANGANESE STEEL INSERT.
FLANGEWAYS IN ELECTRIC RAILWAY
SECTION A-A
SECTION B-B
SECTION C-C
ALTERNATE SHOWN THUS
PLANING AT END OF FLARED GUARDS ON STEAM RUN
ALTERNATE ROD GUIDE
NOTE:- ONE ROD MAY BE OMITTED WHEN SO SPECIFIED HEAD ROD TO BE PLACED 17" FROM POINT WHEN REQUIRED TO PROVIDE FOR INTERLOCKING CONNECTIONS.
HOOK BOLTS FOR ROD GUIDE
BOLT LENGTH
RAIL SECTIONS
ROD GUIDE (MALLEABLE OR CAST STEEL)
NOTES:-
DETAILS FOR
SPLIT SWITCH POINT DERAIL
NOVEMBER 1924.
REVISED - NOVEMBER 1925
PLAN Nº 215

Standard Plans Submitted for Inclusion in the Manual

spots of consequence; (5) chipped and battered rail ends; (6) the amount which the rails which are not chipped are low at the ends; (7) kinks or any other bends in the rails; (8) condition of the rail with respect to corrosion; (9) amount rails have worn under the head and on top of the base due to contact with the joint bars; (10) condition of the joint bars, particularly when there is not sufficient life left in the rails to justify renewal of the joints.

In addition to the preceding, the following conditions should be observed: Condition of ties (as, for instance, a mixture of soft and hard wood); character and condition of ballast and roadbed.

The following notes may be made on the method of securing certain items listed above: The counts of rails with wear spots and rails with driver burns should be made with tally registers while passing over the track slowly; also, notes should be made of the number of rails showing defective spots. Information in regard to chipped and battered rail ends, as well as amount which rails have worn down, also expansion in track, should be secured at convenient intervals by measurements at 10 or 20 joints by use of a straight edge provided at one end with a depth gage reading to hundredths of an inch. In recording these rail end readings, notes should be made as to whether end was chipped or battered.

The amount of expansion should be determined by means of a taper gage (a steel wedge having graduations on one face showing each one hundredth of an inch increase in thickness of the wedge). Temperatures of rail should be taken in connection with expansion measurements. Where rail ends have been built up by welding, such fact should be noted. As additional information, the gage of track should be recorded where other readings are being taken.

Office Statistics—The following statistics should be collected: (1) Gross tons of traffic handled (both freight and passenger). (Railroads usually compile operating statistics from which this information may be taken direct, or estimated.) (2) Characteristics of locomotives, especially total weight on drivers and weight of heaviest driver; also trailer; also weight of car loads, if excessive. As the amount of traffic handled and unit loads are not the full measure of the life of rail, among others, the following items should also be taken into consideration: (3) Gradients; (4) curvature; (5) record of rail failures.

Having available the above information, both from track inspection and office statistics, covering the stretch of track under investigation, the final recommendation as to whether the rail should be renewed at the particular time or not, will depend upon a combination of most or all of these items, bearing in mind the standard of maintenance in use by the company, as well as general conditions.

Under these circumstances, it is impossible to lay down any fixed rules which would be applicable to all railways generally, but it is believed that by carefully collecting this information in the field, and considering it in the office, considerable economies of maintenance may be effected and a much more uniform standard of maintenance attained than without such study.

The committee recommended that this report be accepted as information and published in the Proceedings.

Appendix G—Design of Tie Plates

The committee submitted plan and table of dimensions for tie plates 9 to 12 in. long. These designs have been arrived at not only by analysis, but also by careful study of the dimensions of tie plates in general use at the present time.

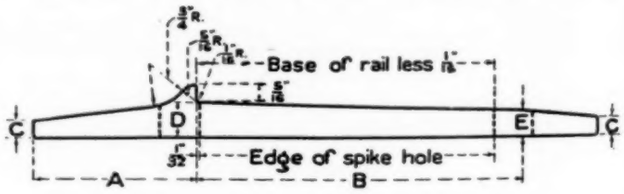
The tie plates of a given dimension are usually used under more than one section of rail and therefore any specific design must necessarily be a compromise. It was thought that the dimensions proposed in this report are the best for general use and that their use will result in a substantial reduction in the number of rolls necessary for the manufacture of tie plates. At the present time there are a large number of rolls for tie plates which vary from each other only in unimportant dimensions.

No recommendation is made as to width of plates for softwood ties, as the character of ties and local conditions vary so much that it is thought best that the width be fixed to suit local conditions.

The committee recommended that the plan and table of dimensions submitted be adopted as recommended practice and printed in the Manual.

TABLE OF DIMENSIONS FOR TIE PLATES

LENGTH OF PLATES	RANGE OF RAIL BASES	SAME FOR FLAT AND CANTED PLATES			FLAT PLATES	CANTED 1 IN 40		CANTED 1 IN 20	
		A	B	C	D & E	D	E	D	E
9"	4¾ TO 5"	2⅛"	5⅛"	⅛"	⅛"	⅛"	⅛"	⅛"	1/16"
9½	4¾ TO 5⅛	2⅛	5⅛	⅛	⅛	⅛	¼	⅛	1/16
10	4¾ TO 5¼	2⅛	5⅛	⅛	⅛	⅛	5/16	⅛	1/16
10½	5⅛ TO 5¾	3	5⅜	⅜	3/16	3/16	5/16	3/16	1/16
11	5⅜ TO 6	3⅛	6⅛	⅜	3/16	3/16	5/16	3/16	¼
11½	5⅜ TO 6⅛	3⅛	6⅛	⅜	¼	¼	5/16	¼	¼
12	6 TO 6⅛	3⅜	6⅛	⅜	¼	¼	5/16	¼	¼



Data for Designing Tie Plates

Ribs not exceeding ¼ in. deep are desirable on the bottom of the plate.

Thicknesses shown are exclusive of any ribs or corrugations on the bottom.

On hardwood ties, widths of 7 or 7½ in. are recommended.

If splices are slotted for spiking, spike holes in tie plates shall be located accordingly.

Spike holes shall be made the size of the spike plus ⅛ in., and in high carbon hot worked plates, spike holes shall have a fillet radius of 1/16 in.

Plates may be rolled with a camber or crown of 1/16 in. if desired by the purchaser.

Where plate is cambered or crowned the shoulder height, 5/16 in. is measured at center of plate.

For extra heavy service add ⅛ in. to dimensions D and E.

Appendix H—Cause and Prevention of Rail Battering and Principles of Joint Design

A questionnaire was sent out to all railroads represented in the A.R.E.A. to ascertain from the various railroads their opinions and experiences in regard to the subject, from which the committee hoped to determine means to eliminate the causes of rail chip-

ping and battering, and to fix, in so far as possible, the principles of joint design.

Answers to the questionnaire were received from 49 railroads, from which the committee was unable to formulate definite rules and recommended that the report be received as information.

Appendix I—Track Construction in Paved Streets

The committee submitted questionnaires on the use of girder rail and T-rail for tracks in paved streets from which statistics were prepared showing the mileage of various sections in use on the 15 roads reporting. Summarized these show for girder rail:

9 in.—141 lb.	46.78 mi.
9 in.—159 lb.	13.83 mi.
9 in.—154 lb.	.13 mi.
Total, 9-in. rail	60.74
7 in.—127 lb.	7.32
Total, girder rail	68.06

Twelve reporting roads express a preference in the use of available girder rail as follows:

4 roads having 26.83 mi. of various sections	159-lb.
5 roads having 22.26 mi. of various sections	141-lb.
3 roads having 11.39 mi. of various sections	127-lb.

The mileage of T-rail in paved streets used by the 15 reporting roads is as follows:

A.S.C.E. 60-lb. and 70-lb.	10.25 mi.
A.S.C.E. 75-lb.	0.75 mi.
A.S.C.E. 80-lb.	0.25 mi.
A.S.C.E. 85-lb.	4.99 mi.
A.R.A. 90-lb.	2.00 mi.
Various sections	100.70 mi.
Total	118.94 mi.

The committee co-operated with the Committee on Rail, the Way Committee of the A.E.R.A. and a special committee of the A.S.T.M. in the preparation of standard specifications for open hearth steel girder rail of plain, grooved and guard types, these specifications being presented by the Rail Committee. The committee also collected data for the preparation of a report covering special track construction.

The committee's conclusions, which it recommended be approved for publication in the Manual, were as follows:

Conclusions

1. Satisfactory results have been obtained from the use of both "T" rails and girder rails in steam railroad track in paved city streets, but considerable expense is involved in the construction and maintenance of the paving as vibration and movement of the rails under the traffic loads accelerate the disintegration of the paving. In order to minimize this detrimental effect it is of importance that the designs of rail sections and joints for this service should embody strength and rigidity. To meet these requirements most economically the following sections of girder rails, splice bars and accessories are recommended:
2. Plan of the 159-lb. Girder Rail Section, to be designated as the "159-lb. G-9 Section."
3. Plan of the 174-lb. Girder Guard Rail Section, to be designated as the "174-lb. GG-9 Section."
4. Plan of the 159-lb. G-9 Joint Bars to be used with the 159-lb. G-9 Section and 174-lb. GG-9 Section, the same to be designated as "159-lb. G-9 Splice Bars."
5. Plan of the 128-lb. Girder Rail Section, to be designated as the "128-lb. G-7 Section."
6. For girder rail construction the use of the 159-lb. G-9 section, except under light rail traffic where the use of 128-lb. G-7 section may be found more economical.
7. In 9-in. girder rail construction the use of the 174-lb. GG-9 section girder guard rail, which fishes with the 159-lb. G-9 section, for guarding frogs and on the inner rail of curves where the life of the outer rail is limited by flange wear rather than by top wear.
8. Bolt holes 1¾-in. diameter drilled in both ends of the 159-lb. G-9 section and the 174-lb. GG-9 section, with their center line 3¼-in. up from the base of the rail and spaced from the ends as follows: 2¾-in.-7½-in.
9. Bolt holes 1⅛-in. in diameter drilled in both ends of the 128-lb. G-7 section with their center line 2¾-in. up from the base of the rail and spaced from the ends as follows: 2½-in.-4-in.-4-in.
10. Splice bars of the sections shown as the 159-lb. G-9 joint bars to be used with the 159-lb. G-9 section and 174-lb. GG-9 section, 26-in. long, with bolt holes punched 2¾-in.-7½-in. 5½-in.-7½-in.-2¾-in.
11. High tensile bolts 1¼-in. in diameter for use with the 159-lb. G-9 section rail.
12. High tensile bolts 1-in. in diameter for use with the 128-lb. G-7 section rail.
13. Ties of the best grade and class, preferably treated.
14. Tie plates of sufficient size to prevent cutting of the ties.

Appendix J—The Value of Nutlocks for Rail Joints with Special Reference to Heat-Treated Bolts of Large Diameter

A questionnaire was sent to all railroads represented in the A.R.E.A. to ascertain their opinions and experiences. Answers to the questionnaire were received from 43 railroads which answers were summarized by the committee but no conclusions drawn. The committee recommended that this report be received as information.

Summary of Answers

Of the 43 replies received 14 state that the true function of a nutlock should be to lock the nut and 24 state that it should have sufficient spring to keep bolts tight.

Nutlocks of the spring washer type are considered satisfactory by 27 railroads; two roads report none are satisfactory, two are conducting tests to determine relative merits, others report as having no choice, no experience or as not being prepared to name, etc.

Replies to this question indicate that 38 roads are in favor of using a nutlock on every bolt, 2 roads are not in favor and others have not replied to this question, or are not prepared to say.

Spring washer types of nutlocks are being used by 39 roads, one road is not using them, others have not answered or are not prepared to say.

Hipower, Plain Spiral, Positive, Ideal, Verona Spring Plates, Hychrome, Eaton High and Low Coil Spring Washers, are among types stated by various roads as being in use.

Nutlocks of the spring washer type are reported as improving joint conditions by 36 roads, 3 report no improvement, others report no information or conducting tests.

Reduction of labor is reported by 32 roads, two roads report no reduction, others report as being undecided, or having no information.

Discussion

J. V. Neubert (N. Y. C.), chairman, presented the report of the committee.

The several slight changes recommended by the committee were approved in order.

Chairman Neubert: *I move that these specifications be adopted and printed in the Manual. Motion carried.*

Chairman Neubert: The proposed specifications for Soft Steel Cut Track Spikes is offered for adoption to be printed in the manual, and *I so move. Motion carried.*

C. R. Harding (S. P.), presented the report of subcommittee No. 2. The different sections of the report were accepted according to the committee's recommendation, without discussion.

During the absence of the chairman, S. B. McConnel (C. P. R.), handled Appendix C, specifications for Hickory Handles for Track Tools.

It was moved that the specifications be adopted for inclusion in the Manual. Motion carried.

E. D. Swift (B. R. of C.), presented Appendix D. Effect of Brine Drippings on Track Appliances and Tests of Tie Plates Subject to Brine Drippings, which was accepted as information.

H. G. Clark (C. R. I. & P.), sub-committee chairman, presented the report on Canting Rail.

C. W. Baldridge (A. T. & S. F.): If you will look back to page 476 of this same bulletin, you will find the Rail Committee have today recommended: first, rails should be canted inward; second, inclined tie plates should be used to produce the desired cant; third, amount of cant should be 1 in 20.

Chairman Neubert: If we go to the design of the tie plates, it is going to bring up this same discussion.

J. V. Hanna (K. C. T.): I question the advisability of saying anything about the amount of cant in this report to be included in the manual.

Mr. Clark: We can discuss this subject as to the amount of cant for the next hundred years and never get any closer to it.

A motion to adopt the recommendations of the committee that the rail be canted inwardly, and that the inclined tie plates should be used to produce the desired result, *was carried.* The third recommendation that the amount of cant should be left to the individual railroads, *was killed.*

Appendix F which was presented by J. deN. Macomb (A. T. & S. F.), was received as information.

J. R. Watt (L. & N.), presented Appendix G, Design of Tie Plates, and moved its adoption.

H. J. Pfeifer (St. L. T.): This conclusion in regard to the tie plate is not consistent with the canting of rail. You make provision for a flat tie plate and in the conclusion which we just adopted we say that the rail should be canted and that the canting should be brought about by the use of a canted tie plate. Therefore, it seems to me that reference to a flat plate should be omitted.

Mr. Watt: There is still considerable demand for flat tie plates, regardless.

Chairman Neubert: The majority of the railroads, have gone into the canted tie plate in the last year or possibly two, having more of the 1 in 40 than the 1 in 20.

Professor Talbot: The dimensions referring to the amount of projection of the plate on one side or the other of the base of the rail, and the position of the head of the rail as well, are for the purpose of taking the lateral pressures, average lateral pressure outwardly, as it would be, on the rail in order to prevent a widening of the gauge, making it rather a tightening of the gauge. My understanding of this design is that there is considerable variation with dimensions given as to whether a rail of one width of base is used or another width. There is a further variation whether the rail is to be canted or not canted.

The motion to adopt the *design of tie plate was carried.*

Appendix H was presented by L. B. Allen (C. & O.), in the absence of Chairman J. B. Myers, and was received as information.

Appendix I, in the absence of the chairman, was presented by O. F. Harting (T. R. A. of St. L.), and was accepted according to the recommendations of the committee.

W. H. Peterson (C. R. I. & P.), presented Appendix J, The Value of Nutlocks for Rail Joints with Special Reference to Heat-Treated Bolts for Large Diameter, *which was accepted as information.*

The committee was excused with the thanks of the Association.

Report on Co-Operative Relations with Universities

This committee has the unique function of interesting itself in this work in other ways than by the production of reports about it. Conspicuous among its aims is that of developing contacts with organizations with the purpose of learning their methods of increasing the employer interest and of interesting the colleges on the subject of transportation and its economics. Considerable progress was reported in establishing such contacts. The principal subject matter was a tentative form of questionnaire which it is proposed to submit to the railroads for the purpose of determining the number, varieties and status of college graduates in the service. Robert H. Ford has been chairman of this committee continuously since its organization in 1923.

R. H. Ford
Chairman

THE committee reported considerable progress in new contacts established during the year with organizations who are working in other branches of industry along lines more or less similar to the activities of this committee. These contacts are beneficial in many ways, not the least of which has been to broaden the perspective on this somewhat complicated problem.

The scope of the activities of the committee is as follows:

(1) A greater interest upon the part of railroad officers in assisting the universities to develop the best possible methods for the technical courses.

(2) A better means of bringing to the universities the results of our deliberations, where such can be made of value to them.

(3) A better means of bringing to the attention of the railroads the benefits of a technical education, thereby acquainting them with the qualifications of graduates of these courses for initial service in subordinate positions, and at the same time providing material from which men may be drawn for higher positions as they demonstrate their fitness.

(4) A means of stimulating a greater interest in the science of transportation among engineering students who may be inclined toward this branch of industry.

(5) A means whereby the facilities of the universities may be made more directly available for the research work of the Association by co-operative effort between their laboratories and the committees of the Association.

(6) A means whereby the universities may be better enabled to educate the students and the public regarding the value of transportation to the nation as a whole.

(7) A means of stimulating a greater interest among university officials in the study of transportation and economics and impressing them with the importance of experienced men for such teaching.

While there is an evident desire on the part of both railways and educational institutions for effective co-operation, there is no doubt that this can be made more effective and correspondingly beneficial. This is caused to some extent by a lack of familiarity on the part of the colleges with the methods, personnel and organization of the railroads, and by a failure on the part of many railroads to appreciate the advantages which would accrue to them through a better familiarity with the great facilities offered by our institutions of higher learning and special training, which inclined the committee to the belief:

1. That the result of the studies so far undertaken indicates that in few, if any, of the university or college faculties is there a clear conception of the kind of training required to fit young men for railway service.
2. That this is largely due to the fact that the college faculties have been unable to secure necessary information from responsible railway officials.

The railways are not interested in getting more men to the colleges or in getting jobs for college men. They are interested in what measures should be taken to convince railway officers that the employment of a sufficient number of properly trained college men is to the advantage of the railroads, and the committee suggested:

3. The railways should not take into their service more college-trained men than they can assimilate.

On the presumption that the best of these young men should ultimately be found among the leaders in the transportaion industry, it is essential that the training in fundamentals should be such as to enable them to advance as rapidly as opportunity, environment and association will permit. While no doubt this applies to other major industries, it applies with equal force to transportation. With this in view, it was suggested:

4. That the engineering schools do not specialize beyond the three branches of engineering; viz., civil, mechanical and electrical.

The ultimate effect on personnel resulting from the various methods of employment which are found among railroads and other principal industries, and the extent that specialization may be properly undertaken by the universities and colleges, together with other allied subjects, are also under investigation by the committee.

A tentative form of questionnaire was included in the report, in the hope that constructive criticism and suggestions may be obtained. This is somewhat similar to the form which is being used by several of the major industries.

Committee: Robert H. Ford (C. R. I. & P.), chairman; Edwin B. Katte (N. Y. C.), vice-chairman; R. N. Begien, (C. & O.), W. C. Cushing (Penna.), J. M. R. Fairbairn (C. P. R.), W. D. Faucette (S. A. L.), F. W. Green (St. L. S. W.), E. T. Howson (Ry. Age), Milo S. Ketchum (U. of Ill.), C. H. Mitchell (Toronto U.), C. A. Morse (C. R. I. & P.), G. J. Ray (D. L. & W.), Wm. G. Raymond (State U. of Ia.), Henry E. Riggs (U. of Mich.), H. R. Safford (G. C. L.), Geo. F. Swain (Harvard U.).

Discussion

[R. H. Ford (C. R. I. & P.), presented the report.]

Prof. S. L. Conner (Tufts College): The college faculties have been responsible for the training of men who are carrying on the railroad work today. I don't think they have made much of a failure as evidenced by this meeting. The colleges, I believe, stand ready to do what is right in relation to the training of men for railroad work.

Chairman Ford: The second section: That this is largely due to the fact that the college faculties have been unable to secure necessary information from responsible railway officials.

Prof. Conner: I realize that the problem before this committee is a difficult one and that this Association is doing a work that is really worth while. I would like to offer a practical suggestion in relation to the problem, and that is that the American Railway Engineering Association have a representative on the platform of the Society for the Promotion of Engineering in June, to present this problem in all its angles so that the people interested in engineering may realize that the problem is not limited solely to one phase of engineering work.

J. B. Jenkins (B. & O.): There is another angle to the third recommendation. Many railroads encourage college men to enter their ranks in subordinate positions in order to begin at the bottom and learn the railroad business, and then after these subordinates have entered the ranks of the railroad, the railroad company forgets them. They should follow up these college men and see which ones are making good and give them an opportunity to accumulate experience in different departments of the road.

G. D. Brooke (C. & O.): If a railroad has to follow up a college man when he enters the service to see that he gets along, it is rather taking the position that he isn't as well able to take care of himself as the other men in the service who are not college men.

W. H. Woodbury (D. M. & N.): I am in accord with the committee's fourth recommendation.

Mr. Jenkins: The man who is capable of looking out for himself is very often denied the opportunity to acquire the necessary experience.

Chairman Ford: I am going to ask Mr. Cushing if he won't close on No. 1.

W. C. Cushing (Penna.): You will observe that the subject is a very large one indeed and it is noticeable that the committee has only started with the presentation of four general statements.

Section No. 1 reads, "That the result of the studies so far undertaken indicates that in few, if any, of the university or college faculties is there a clear conception of the kind of training required to fit young men for railway service."

That sounds presumptuous but is derived from the statement of an educator. It means that railroad officers must become aggressive and cease to be apathetic.

One's official duty is in consonance with self-interest, so this problem of settling upon the right course in education requires deep thought and study. College training should be based on instruction and thorough grounding in fundamental principles of the major branches. The ambitious boy must pursue his special research work in a post-graduate study in a school of special eminence and in the execution of his official work. He must never cease to be a student.

Dean M. S. Ketchum (U. of Ill.): When I graduated from college, I was told when I applied for a job to fail to mention the fact that I was a college graduate. Since that time there has been a very decided change in the attitude of industries toward the technical graduate. Today industries are very anxious to take technical graduates in their employ. Industries have found that technical graduates with a training in sciences and mathematics and mechanics have been able to develop more rapidly, solve new problems, were more aggressive; were better able to compete with other industries, and that these men reached a position of administrative maturity at a much younger age than the same men would who had not had that training.

Now, industrial schools have been cooperated with by industries to a considerable extent. If the railroads will follow with the industries, I am sure that men will look

to the railroads for their future life work much more than at present.

The main difficulty in handling college men is that in many cases they haven't been given a job sufficiently large. I would say that ordinarily you had better give them a job altogether too large. If they fail, fire them. They will take that kind of treatment, but they must have an opportunity to see that they can do a man's work, and if they see this opportunity, and if the railways will indicate to them the opportunity is ahead, there will be no difficulty in getting purer, live, wide-awake college men to enter railway service. You must, however, be careful not to get a larger number than you can absorb into your organization, because if you do you will soon find them going the other way.

Chairman Ford: Mr. Howson will close on No. 3.

E. T. Howson (Railway Age): In discussing subject No. 3 we should have the proper realization of the function of this committee. Its purpose is not to find jobs for college graduates, because our members of faculties on this committee vouch for the fact it is no problem to find a job for the graduates. Rather, the function of this committee is to endeavor to develop the thought that there is a place, to the advantage of the railways, for college men in railway service. We are thinking of it from the standpoint of the railway rather than the man. If other industries find it to their advantage to take college men in at the bottom and give them a course of training to fit them for positions of leadership in those industries, there should be a lesson in this for the railways. Men coming into high positions are more and more coming from the relatively small number of men of college training on the railways.

Therefore, I think in referring to a point Mr. Brooke made, that it is not the problem of coddling of the college man so he may have more rapid promotion, but it is giving him an opportunity so that when the railway needs him he will be qualified to assume leadership.

If he gets into a blind alley, as Mr. Jenkins has commented on, he will not have that training and will not be fitted for a more important position later if an opportunity arises.

That railway is unfortunate that takes into its service too many college men, because they clog the avenues, the channels of promotion; rather, it is better to take a smaller number of men in and give a future to those men who make good.

Conditions in the railway industry are changing rapidly and a higher grade of leadership is required each year. It is the thought that the college men should provide a logical portion of that leadership.

Chairman Ford: Mr. Katte will close Article 4.

E. B. Katte (N. Y. C.): It is suggested that the engineering schools do not specialize in the training of prospective railroad men beyond the three branches of engineering; namely, civil, mechanical and electrical. I think that the majority of employing officers in railroads would rather have a boy well grounded in the fundamentals of engineering rather than have him specialize in some particular branch of railroad engineering.

[The committee was excused with the thanks of the Association.]

Report of the Committee on Rail

A pressing problem for rail students is the elimination of the transverse fissure. This year's report of the committee affords information concerning progress in studying this subject. The usual chart of rail failures is brought up to date and a final report is submitted for inclusion in the Manual on a recommended design of track bolts. A unique feature of the committee's work is the presentation of a comprehensive monograph by the vice-chairman, Hunter McDonald, concerning two years' observation on the relation of bolt tension to mechanical strength of joints, a monograph which is also replete with authentic data concerning rail battering with notes on end overflow and chipping. G. L. Moore is completing his second year as chairman of the committee and has been a member for four years.

G. L. Moore
Chairman

THE Committee on Rail submitted reports as follows: (1) Revision of Manual. The committee proposed material for Manual revision as follows: Revised Specifications for Spring Washers—Appendix A. Recommended design for track bolts, including corresponding joint bar punching—Exhibit A.

(2) Design for Track Bolts. The committee presented a recommended design for track bolts, including corresponding joint bar hole, as Exhibit A. This design accords with the recommended design presented last year as a progress report, with the exception of revised dimensions and radii for the shoulder of the elliptical neck track bolt. During this year the New York Central and the Pennsylvania Lines, which are the principal users of elliptical neck bolts, have agreed upon the dimensions shown in Exhibit A as satisfactory.

As now presented, the design shows optional properties for contour of shoulder, type of thread and periphery of nut. The committee believes that this design meets conditions existing on the majority of American track for renewals and may be adopted generally for new construction.

The manufacturers of track bolts have approved the

design and the American Engineering Standards Committee will adopt this as standard when ratified by the Association.

(3) **Mill Practice**—The committee was gratified at the action of the Board of Directors of the American Railway Association in adopting its 1925 standard specifications for open-hearth carbon steel rails as recommended practice for the engineering division. During this year many contracts have been closed with practically all the American steel mills for rail rolled under the provisions of this specification, without change and without premium, and certain mills have adopted the specification as manufacturers' standard.

The committee is devoting close attention to the behavior in track of railrolled during the last three years, whose manganese content is considerably above that now specified as a maximum in its standards. Most of this rail has been made with a manganese content between 1.25 per cent and 1.50 per cent with but little change in the carbon, and appears to justify the belief that greater hardness is being obtained without sacrifice of toughness.

(4) **Rail Failures**—The committee presented rail failures statistics for the period ending October 31, 1924, as Appendix B. The average failures per 100 track miles per year of service for all the rail reported on are given below:

TABLE 1—AVERAGE FAILURES PER 100 TRACK MILES

Year Rolled	Years' Service 0	1	2	3	4	5
1908	.....	.....	.....	.....	.....	398.1
1909	.....	.....	.....	.....	224.1	277.8
1910	.....	.....	.....	124.0	152.7	198.5
1911	.....	.....	77.0	104.4	133.3	176.3
1912	.....	28.9	32.1	49.3	78.9	107.1
1913	2.0	12.5	25.8	44.8	69.5	91.9
1914	1.2	8.2	19.8	32.9	50.9	74.0
1915	0.7	8.9	19.0	34.2	53.0	82.4
1916	1.6	11.8	29.2	47.7	70.6	105.4
1917	5.3	21.6	38.9	66.0	110.5	137.0
1918	1.6	8.9	27.6	54.0	92.8	125.4
1919	2.0	14.8	39.4	73.7	104.8	115.7
1920	3.9	14.2	32.4	63.1	84.5	.....
1921	1.6	10.9	34.9	56.9	.....	.....
1922	1.5	15.9	34.8	.....	.....	.....
1923	3.7	14.3	.....	.....	.....	.....
1924	3.0	.....	.....	.....	.....	.....

The record of performance of the 1919 rolling follows the good showing of the 1918 rolling in presenting another marked drop in the failure rate, and it is expected that the 1920 rolling will continue in the same good course.

The committee is again presenting in the rail failure report a chart showing the rating of mills through the use of the traffic density factor, as well as the rating of its usual method.

(5) **Transverse Fissures**—Data have been compiled covering approximately 16,000 fissures, complete data as to mill and track history being available on about 7000. These data will be analysed by the Statistical division of the American Railway Association during the next few months and presented to the conference headed by the Bureau of Standards of the Department of Commerce, as our contribution of facts toward the investigation.

Through the co-operation of the University of Illinois, specimens of rail steel representing fissured heats and heats in which no fissures have ever developed are still in process of examination for the determination of their respective elastic constants. While the work is not yet complete, the tendency of the data indicates a very interesting difference between the two classes of material, although it is doubtful whether methods can be worked out by which material with this tendency can be identified at the mills.

(6) **Relation of Bolt Tension to Mechanical Strength of Joints**—The committee presented, as Appendix C, a monograph by Hunter McDonald concerning his two years' observation of a mile of test track on the Nashville, Chattanooga & St. Louis.

It was expected that the work conducted by the Committee on Stresses in Track would continue laboratory investigation in determining the relation between bolt tensions and girder strength of joint for values of bolt tension other than the 1000 lb. and 12,000 lb. reported upon last year. This work, however, has been discontinued, and that committee is now engaged in studying this problem by actual observation in track of stresses set up by rolling loads in joints whose bolt tension has been accurately determined. In view of this situation the Committee on Rail desires to be relieved of further consideration of this subject, as it has largely exhausted its own resources.

(7) **Rail Battering**—The committee reported progress on this subject in co-operation with the Committee on Track, and again called attention to Mr. McDonald's monograph, which contains much valuable data bearing directly upon this problem.

(8) **Welding of Traction and Signal Bonds**—The committee reported progress on this subject, and presented, as Appendix D, a metallurgical report on the effect of welding in changing the structure of the rail.

The committee was not ready to make any recommendations concerning the relation of the stresses in track to the changed structure, but presented Appendix D as information.

(9) **Specifications for Spring Washers**—The committee presented, as Appendix A, Revised Specifications for Spring Washers. The principal changes cover provisions for testing of elliptical springs, which are now coming into considerable use, and describes the method of testing more clearly than the present standard.

(10) **Wheel Loads Upon Rail**—The committee presented, as Appendix E, a report worked out by the engineer of tests summarizing the work heretofore on record bearing upon this problem. It has proved impossible for the committee to finance a program for the accumulation of any further data, as it appears that a special track must be set aside for the work, with facilities for placing repeated rolling loads of various intensities during a considerable period of time. A very large amount of laboratory work would be necessary on specimens removed at regular intervals. It has proved impossible to work out the mechanical principles involved through work on cold rolled steel strip. Inasmuch as the committee can now see no avenue of furthering this research, it respectfully requests that it be relieved of further study of this subject until some new opportunity of attack may present itself.

(11) **Economic Value of Different Sizes of Rail**—The committee reported progress on this subject, but has not yet succeeded in analysing the various elements involved therein, and asked that this subject be re-assigned for continued work. It presented as Appendix F a study by the Reading Company on the structure of typical 100 lb. and 130 lb. rails as information.

(12) **Specifications for Girder Rails**—The committee presents Standard Specifications for Girder Rails in Appendix G. While girder rail is only used by steam railway lines in pavement through city streets and will probably never aggregate over one hundred miles, it has seemed wise to co-operate with the American Electric Railway Engineering Association in revising their standard to conform as closely as possible with

our T-rail standard in metallurgy and mechanical requirements. This specification has been ratified by the American Electric Railway Engineering Association and adoption of it by this Association will set a common standard.

(13) **Rail Canting**—The committee last year concurred in the findings of the Special Committee on Stresses in Track and recommended that:

(1) Rails should be canted inward. (2) Inclined tie plates should be used to produce the desired cant. (3) Amount of cant should be 1 to 20.

Action upon the report was deferred at the last convention. The Rail Committee still concurs in these findings and again presents the same recommendation.

The Committee recommended: 1. That specifications submitted with this report in Appendix A, Specifications for Spring Washers, be adopted by the Association and substituted for the corresponding specifications now printed in the Manual. 2. That the design of Track Bolts, submitted with this report as Exhibit A, Design for Track Bolts, be accepted as an American Railway Engineering Association standard and printed in the Manual.

3. That Appendix G, Specifications for Girder Rails, be adopted as an American Railway Engineering Association standard and printed in the Manual.

Committee: G. L. Moore (L. Y.), chairman; Hunter McDonald (N. C. & St. L.), vice-chairman; E. E. Adams (U. P.), J. E. Armstrong (C. P. R.), W. J. Backes, A. F. Blaess (I. C.), F. L. C. Bond (C. N. R.), C. B. Bronson (N. Y. C.), W. C. Cushing (Penna.), C. F. W. Felt (A. T. & S. F.), L. C. Fritch (C. R. I. & P.), E. A. Hadley (M. P.), C. R. Harding (S. P.), John D. Isaacs (S. P.), C. W. Johns (C. & O.), R. Montfort (L. & N.), A. W. Newton (C. B. & Q.), W. H. Penfield (C. M. & St. P.), G. J. Ray (D. L. & W.), Earl Stimson (B. & O.), F. M. Waring (Penna.), Louis Yager (N. P.), J. B. Young (Reading).

Appendix A—Revised Specifications for Spring Washers

General Scope

1. These specifications cover rail joint spring washers of two types: (a) Elliptical springs exerting unit tensions on two bolts of the joint, (b) Helical springs exerting tension on individual bolts. Two classes of helical springs are covered: B1—High spring pressure and B2—Low spring pressure. The purchaser shall specify under which class inspection shall be made.

Materials

2. Material shall be of a carbon steel or an acceptable alloy steel, manufactured either by the basic or acid open-hearth, the electric furnace, or the crucible process.

Chemical Requirements

3. The chemical composition of the spring washers manufactured from each melt of steel shall be within the following limits:

Phosphorus—not to exceed 0.05 per cent.
Sulphur—not to exceed 0.04 per cent.

Physical Requirements

Testing Machine—4. Test specimens shall be interposed between the platens of a compression machine of approved design, equipped with a deflection instrument calibrated to 0.0001 inch and located so that readings are recorded from approximately the center point of platens, and shall be subjected ten successive times to the preliminary loads.

(A) Physical Requirements for Elliptical Spring Washers

Preliminary Load—5. The preliminary load shall be 30,000 lb., and the distance between the platens measured after the tenth application.

Reaction—6. The spring shall then be subjected to a load of 20,000 lb. at which point the distance between the platens shall be at least 1/32 in. (.03125) greater than a similar distance measured under a load of 30,000 lb.

Hardness—7. The test specimens shall show hardness on Brinell scale of between 321 and 418.

(B) Physical Requirement for Helical Spring Washers

Spring Pressure, Method of Determination—8. After the application of the tenth preliminary load, the distance between platens of testing machine shall be measured. Load shall then be released and reapplied and again distance between platens measured. These two distances shall not vary by more than .001 inch.

Test specimens shall then be removed from the testing machine, micrometered, and the maximum thickness of material recorded in 0.001 inch. To each figure thus obtained shall be added a reserve factor of 0.02 inch, and the resultant figure shall be called the test height.

The platens of the testing machine shall then be brought together so that when they are in full contact the deflection instruments register zero. The platens shall then be released and test specimens placed approximately at the center of the lower platen. A test load as given in the table below shall then be applied and the distance between platens as recorded on the deflection instrument shall be equal to, or greater than, the test height as above defined.

Spring Washer Number	*For Diameter of Bolt in Inches* Body	Thread	*Low Spring Pressure* Preliminary Load in Lb.	Test Load in Lb.	*High Spring Pressure* Preliminary Load in Lb.	Test Load in Lb.
1	¾	⅞	Down to Solid	750	15,000	7,500
2	⅞	1	Down to Solid	850	17,500	8,500
3	1	1⅛	Down to Solid	1,000	20,000	10,500
4	1⅛	1¼	Down to Solid	1,250	25,000	11,500
5	1¼	1⅜	Down to Solid	1,500	28,000	12,000
6	1⅜	1½	Down to Solid	2,000	36,000	15,000
7	1½	1¾	Down to Solid	.....	45,000	18,000

Hardness—9. The test specimens shall show hardness on the Brinell scale of between 402 and 477.

(C) Physical Requirements Common to Both Elliptical and Helical Springs

Fracture Test—10. When test specimens are nicked and broken, the structure at the fracture must be of fine grain, homogeneous, or of uniformly silky structure.

Proportion of Tests—11. (a) Tests shall be made from specimens selected by the inspector at random from lots of not over 15,000 pieces of finished helical spring washers and not over 7500 pieces of elliptical spring washers offered for inspection. Two specimens shall be selected for each test (pressure, fracture, and hardness), and if both meet the requirements of the specifications, the lot will be accepted. If one of the specimens fails, a third shall be selected and tested, and if it meets the requirements of the specifications, the lot will be accepted. If, however, the third test piece fails, the lot will be rejected.

(b) When required, the manufacturer shall furnish samples from a preliminary lot before proceeding with the fulfillment of the order and give sufficient notice in advance of the date when they will be ready for inspection.

Temperature of Test Specimens—12. The temperature of the specimens at the time of test shall be between 60 and 110 deg. Fahr.

Reheat Treatment—13. (a) If the results of the physical tests do not conform to the requirements specified, the manufacturer may reheat-treat such a lot, but not more than three additional times, unless authorized by the purchaser, and retests shall be made as specified in Section 11.

(b) No lot which has failed to pass the tests shall be offered for further test until after the spring washers in that lot have been re-treated.

Designs and Tolerance

Design—14. Spring washers shall be made in accordance with the standard sizes, dimensions and forms, as specified by the purchaser.

Tolerance—15. The weight of finished spring washers per thousand lot shall be at least 97 per cent of the theoretical weight, the weight of a cubic inch of steel being taken as 0.2833 lb.

Manufacture

16. (a) Previous to offering any lots of spring washers for inspection, each individual piece shall have been subjected as a part of the routine manufacturing process to shock or pressure sufficient to eliminate permanent set and any individual pieces defective through seams, quenching cracks, etc.

(b) Heat treatment shall conform to the best known methods for securing the desired physical properties.

(c) All spring washers must be clean, smooth, without burrs or rough edges, of uniform size and cross-section, free

from injurious mechanical defects, and be finished in a first-class, workmanlike manner.

INSPECTION

Place of Tests—17. All tests and inspection shall be made at the place of manufacture prior to shipment, unless otherwise agreed, except that check tests may be made at any other place selected by the purchaser without holding the manufactured articles at the mill awaiting the results of the check tests, and shall be so conducted as not to interfere unnecessarily with the operation of the mill.

Access to Works—18. Inspectors representing the purchaser shall have free entry at all times, while the contract is being executed, to the works of the manufacturer, and shall have all reasonable facilities afforded by the manufacturer to satisfy them that the spring washers are furnished in accordance with the terms of these specifications.

Defects Found After Delivery—19. Spring washers to the extent of five per cent or more of the order which show injurous defects subsequent to their acceptance at the place of manufacturer or sale will be returned to the manufacturer, who shall pay the freight charges both ways and replace the defective spring washers with new ones fulfilling the requirements of the specifications.

SHIPMENT

Packing and Branding—20. (a) Finished elliptical spring washers shall be packed in bundles of 25, securely fastened with wire. Finished helical spring washers shall be packed in quantities of 1000 or 1500 in securely hooped kegs or well-fastened boxes. Containers shall be left open until the inspection is completed.

(b) All containers or bundles shall be marked by the manufacturer as follows:

Elliptical Spring Washers

1. Name of manufacturer.
2. Name of railroad and drawing number showing joints on which springs are to be used.
3. Bolt hole centers.
4. Short diameter of holes.
5. Rail section.
6. Label—"HIGH PRESS. ELL. SPG. WASHERS."

Helical Spring Washers

1. Name of manufacturer.
2. Size (nominal bolt diameter).
3. Number of spring washers.
4. Label—B-1—"H I G H PRESS. HEL. SPG. WASHERS"; B-2—"LOW PRESS. HEL. SPG. WASHERS."

Appendix B—Rail Failure Statistics for 1924

This report deals with the rail failure statistics for the year ending October 31, 1924, and continues the method adopted as standard last year of basing the failure rate by mile years of service in track.

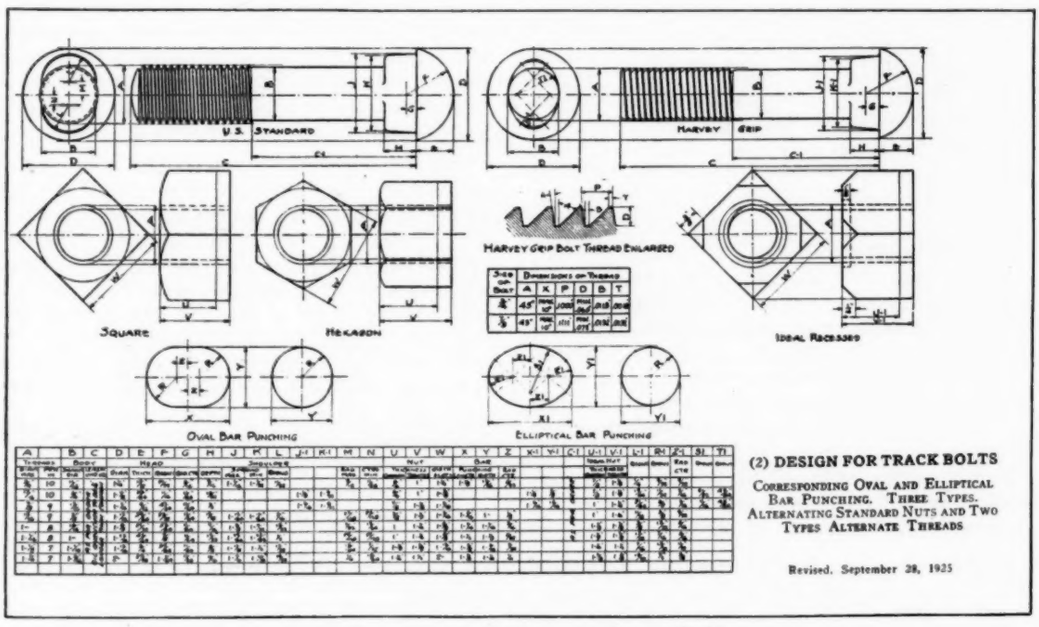
The rollings for 1919 and succeeding years are embodied in these statistics. The tonnage and track miles represented are as follows:

Year Rolled	*Tons*	*Track Miles*
1919	884,805	5,913.86
1920	1,060,750	7,271.00
1921	1,048,771	6,857.55
1922	1,093,960	6,974.38
1923	1,514,717	9,501.95
1924	714,676	4,519.04

The 1919 rollings, whose period of observation is now concluded, exhibit another substantial drop in the curve, following the drop recorded last year from the peak of the 1917 record. The four-year record of the 1920 rollings justifies a further drop at least equal in amount next year, and it would seem that the low record of the 1914 rollings will be attained during the next three years.

Appendix C—Effect of Various Bolt Tensions on Mechanical Strength of Joints, and Cause and Prevention of Rail Battering

This appendix consisted of a monograph by Hunter McDonald, chief engineer of the Nashville, Chattanooga & St. Louis, vice-chaiman of the committee and a past president of the Association, presenting results of two years' observation of a mile of track. The monograph is exhaustive and contains much valuable data, supplemented by exhibits.


U.S. STANDARD
HARVEY GRIP
HARVEY GRIP BOLT THREAD ENLARGED
SQUARE
HEXAGON
IDEAL RECESSED
OVAL BAR PUNCHING
ELLIPTICAL BAR PUNCHING
(2) DESIGN FOR TRACK BOLTS
CORRESPONDING OVAL AND ELLIPTICAL BAR PUNCHING. THREE TYPES. ALTERNATING STANDARD NUTS AND TWO TYPES ALTERNATE THREADS
Revised. September 28, 1925

Recommended Design of Track Bolts

The author described the characteristics of the track under observation and the instruments developed to carry on this work.

Under the subject of the effect of various bolt tensions on the mechanical strength of joints he discusses rail creeping, tests with calibrated spring washers, types of nuts and length of wrenches, rail anchors and expansion allowances, and closes with a discussion as to the importance of bolts as follows:

"A necessary condition toward the attainment of the ideal is that of uniformity of bolt tension adjusted and maintained to approximately the amount of tension necessary to develop full strength of the joint.

"There is no feature of track maintenance which yields a larger return for the labor expended than properly adjusted track bolts. Bolts which become

loose set up movements in the joint which tend to induce excessive batter and destroy the supporting power of the cross-ties and ballast. On the other hand swinging ties under or near a joint induce loose bolts, thus forming a "vicious circle" which if permitted to enlarge its radius becomes destructive and dangerous. The loosening of bolts can be detected before it has gone too for by tapping the heads of the bolts with a small hammer; bolts which are too tight can be detected in the same manner. Regular inspections should be made with the hammer and the heads of bolts requiring tightening marked with yellow crayon for the notice of the trackmen. The desirable length of the wrench handle will depend on the type of nut used, whether "free turn" or "wrench tight." Whatever length may be adopted finally after the desirable length has been determined as a result of further investigation should be rigidly adhered to and the use of gas-pipe extensions prohibited, except where nuts are frozen and help is not available."

In the study of the cause and prevention of rail battering the author discussed the resistance of Bessemer and open hearth steel to battering and sated that in his view the process of manufacture as between Bessemer and open hearth is not conclusive as to superior resistance to batter shown by the lighter sections of rail in comparison with the heavier.

The behavior of old rails with respect to battering was investigated as well as rail of recent rollings. The author stated that the only fact which seems to have established beyond reasonable controversy is that rail battering is directly proportional to the width of the joint gap.

Studies were also made of the chemical content, ladle analysis, and influence of heats on the rails under observation, and it was the author's opinion the best course to be pursued in the prevention of rail battering or reducing its intensity is to study carefully the heat treatment and metallurgy of those rails which show the least tendency to batter and when the conditions which bring about this quality of minimum batter are discovered, some method of manufacture which will bring the output of the mill up to the point of that or even better quality should, if possible, be devised and put into practice.

Appendix D—Metallugical Report on the Effect of Welding in Changing Structure of Rail

This report contains the findings on six 36-in. lengths of sections 11025 rails from heat No. 34282, to which have been welded three specific sizes of traction and signal bonds by each of the following companies: The Ohio Brass Company, Mansfield, Ohio, and the American Steel & Wire Company, of Worcester, Mass.

Tabulation of Samples Received

Rail Sample	No. Applied	Location	Spaced	Type	Name
Bonds applied by the Ohio Brass Company:					
1	5	Outside of head	8" centers	OB-13997	Stub end Signal
2	5	Outside of head	8" centers	OB-ST-2	Gas weld rail bond
3	6	Outside of head	11" centers	OB-ST-5	Heavy propulsion 500,000 c.m. cap

Bonds applied by the American Steel & Wire Company:

Rail Sample	No. Applied	Location	Spaced	Name
4	4	2 on outer side head	2" from ends	Signal bond
		1 on web	15" from end	
		1 on flange	21" from end	
5	4	Same as No. 4	Same as No. 4	4/0 Propulsion
6	4	Same as No. 4		Heavy propulsion 500,000 c.m. cap

Chemical Analysis

	C	Mn	P	S	Si
Ladle of heat No. 34282	.80	.74	.034	.033	.19

A study was made of the areas affected in the rails by the welding operation as revealed by the microetchings. In the area nearest the weld there was slight skin decarburization which was almost negligible—then the harder, somewhat refined grain was evident; adjoining this at increasing depths were found nearly sorbitized rail steel and then the fine grain merges to the original structure. The Brinell hardness varied between 364 in region immediately adjacent to weld; dropping down to 302 in gradation zone; and giving 286 of the rail as rolled. Physically, this variation could be expressed somewhat as follows for a piece of the unaffected head when sorbitized gave:

100,275 lb. per sq. in.—Yield point
154,565 lb. per sq. in.—Ultimate tensile
14.00%—Elongation
35.41%—Reduction of area

while the rail as rolled gave:

79,420 lb. per sq. in.—Yield point
138,150 lb. per sq. in.—Ultimate tensile
9.00%—Elongation
13.08%—Reduction of area

Appendix E—Study of the Effect of Various Intensities and Repetitions of Wheel Loads Upon Rails

The assignment of this subject by the Board of Direction for study was considered by the committee an effort in a new direction toward accumulating data concerning the condition primarily responsible for the deterioration of good-wearing rails in track, as well as the development of most of the dangerous rail failures.

The committe outlined the studies made on this subject and concluded with the following statement:

The committee believes that neither the quantity of the load nor the intensity of pressure are the sole contributing causes to failure in track of any given design, metallurgy or composition of steel rail. It further believes, provided the rail is resistant to abrasion and flow, that the stresses of surface compression balanced by interior tension are cumulative and that even our lightest normal wheel loads over a period of years will produce through cold rolling cumulative strains of notable penetration into the rail head.

Further work will have to take into consideration the number of repetitions of loads of various quantities and intensities before the fundamental data can be secured. A large number of strain readings must be taken from thin slices cut in various planes from the affected areas in order that the results may be fully trustworthy. The committee is unable to finance such work.

Appendix F—Study by the Reading Company on the Structure of Typical 100-Lb. and 130-Lb. Rails

FOREWORD

This investigation was instituted in June, 1924, in order to substantiate, if possible, the opinion that the 130-lb. RE section rails were softer than the rails of lighter section, the 100-lb., for instance. If this could be proven, the reasons for the poor conditions reported of the 130-lb, rail after short service as compared with the 100-lb. rail, could then be readily understood.

In order to carry the investigation to an ultimate conclusion, it was found necessary to do practically all the microscopic work at a magnification of 4,500 to 5,000 diameters. This magnification was necessary to facilitate measurements and mathematical calculations. As few investigators have attempted work at this magnification, a technique had to be developed. This explains in a measure the length of time needed to obtain satisfactory results.

After describing the processes of conducting the study

the paper concludes with the following recapitulation and conclusions:

RECAPITULATION

1. The 130-lb. rails as a class are softer than the 100 lb. rails.

2. The average decarburization at the surface is practically the same for both the 130 and 100-lb. rails, showing that the excessive metal flow of the 130-lb. rails is not due to abnormal decarburization. This, however, does not show that the finishing temperatures of the 130-lb. rails was probably no greater than that of the 100-lb. rails in the same mill.

3. The 130-lb. rails have a coarser pearlite than the 100-lb. rails.

4. The carbon content has no influence on the coarseness of the pearlite. It follows that the carbon has no influence on the hardness, particularly in the case of rail steels whose average compositions are approximately eutectoid. Thus they are entirely pearlitic with no excess of ferrite that occurs below, or cementite that occurs above the eutectoid point, that would tend to soften or harden the steels, respectively.

(VIII) CONCLUSIONS

From the foregoing evidence the 130-lb. rails are seen to be softer than the 100-lb. rails. However, there is another point that deserves to be mentioned. In service the comparative softness of the 130-lb. rails is accentuated by the fact that these rails present a stiffer, stronger girder than the 100-lb. rails and do not assume the same deflection under passing loads as do the 100-lb. rails. Consequently, we should expect the cold work of the passing loads to produce an excessive metal flow, which is the case.

The coarse pearlitic structure, which is the cause of the comparative softness of the 130-lb. rails, may be explained by the following significant fact. The 130-lb. rails have a considerably greater mass than the 100-lb. rails. Thus, after finishing, the retarding effect on the cooling produced by this greater mass will allow the pearlite to become quite coarse with characteristic softness. To be sure the 130-lb. rails have received slightly less work than the 100-lb. rails, but this effect on the condition of the pearlite is not as important as the inflence of the mass.

Since the required hardness with necessary toughness can only be obtained by increasing the fineness of the lamellæ of the pearlite grain, the problem of making 130-lb. rails more serviceable narrows down to the following possibilities: Using the same section, the desired structure may be obtained by increasing the velocity of the cooling in the transformation range by quenching in air or water. Quenching in air is what is generally practiced in the Sorbitic process and the sorbite thus produced is nothing more or less than an extremely fine-grained pearlite. Another aid would be the lowering of the finishing temperature as is used in some mills, for a high finishing temperature promotes the growth of coarsely laminated pearlite, while finishing at a somewhat lower temperature produces a finer grained pearlite. The wider spacing of the rails on the cooling bed will also have a beneficial effect. Steel makers that these two suggestions apply to will of course frown on them, as they would tend to make their production appreciably slower.

Probably the most pertinent suggestion is that the mass of metal in the head be decreased or the shape of the section altered. The former will automatically increase the velocity of the cooling through the transformation, making a fine grain. The latter will also have the same result provided the alterations are such that the section will cool more uniformly than it does at present.

The rails rolled with a high manganese content cannot be included here, as none of them have been investigated. However, this rail would not be entirely comparable to the simple carbon steels investigated here, as the high manganese rail is in the alloy steel class and has many characteristics peculiar to it alone.

Finally, the most appropriate combinations of conditions for improving the condition of the 130-lb. rails from both an economic and metallurgical standpoint would be the reduction of the mass in the head and the lowering of the finishing temperature in mills where it is applicable.

Discussion

The afternoon session was called to order by J. L. Campbell (S. P.), a Past President of the Association.

The report was presented by Chairman G. L. Moore (L. V.).

Chairman Moore: Before we start with the regular work of the committee Mr. Ray wishes to make a statement to the Convention.

G. J. Ray (D. L. & W.): On January 5, 1926, a patent was granted to H. J. Force on rail steel. The application for this patent was filed on July 17, 1925. As soon as Mr. Force received his patent papers he took steps to notify several of the steel companies and also some of the railroads that he would expect a royalty of $3 a ton and also indicated that in case of infringement legal action would be taken for triple damages.

Assuming that Mr. Force's patent is good (personally I think it is worthless) and that he could do all that he claims, most of us would probably use this rail.

Note a few of the claims summarized as follows: With this steel the section is stiffer, shows greater ductility, has a higher average hardness, breakage and rapidity of wear and disintegration are reduced, transverse fissures are materially eliminated: In fact this steel is of such superior quality that it is possible to reduce the size of rails; also difficulties and losses ordinarily encountered in the manufacture of steel rails under present processes are avoided. In other words, it is claimed that this invention will make it possible for us to use lighter rails with greater safety and permit the steel companies to manufacture this material at less cost.

For the benefit of those who are not familiar with many of the facts, permit me to say to you that Mr. Force is the chemist and engineer of tests of the Lackawanna. For the past 17 years the speaker has been chief engineer of the Lackawanna and during this time has had entire charge of the rail problem. Our general steel inspector has charge of all operations at the mill and reports directly to the chief engineer. The only work handled by the chemist and engineer of tests is such chemical analyses as are required.

My object in addressing the Association on this subject is three-fold: 1. I wish to correct some of the errors in the statements that have been sent out in an attempt to advertise the patent in question. 2. I wish to make it plain to all concerned that the communications concerning this patent which Mr. Force sent to the steel companies and to officers of some of the railroads were sent out without the authority or consent of his superior officers and should have been handled as a personal matter instead of emanating from the chemist and engineer of tests of the Lackawanna railroad. 3. I have received many inquiries concerning this rail from officers of other railroads. I have gladly given out information and advice to the best of my knowledge and belief, but in all

cases I have been very cautious not to strongly recommend this steel and I have been careful to state that in my opinion the rail has not yet had a sufficient trial to warrant any extravagant statements. I want to make it clear that I am in no way interested in the patent granted to Mr. Force and had no idea that he applied for a patent until after it was granted.

As early as January, 1911, we accepted one heat of steel rolled at the Lackawanna plant in Buffalo, the test ingot showing carbon of 0.56 and manganese of 1.21. This rail was carefully watched in service, but did not give any better life than other rail from the same plant. Part of this rail was laid on a curve and had to be turned in 18 months. It was all removed from the track by the end of 30 months. Two failures occurred during the life of the rail.

Two more heats of this steel were rolled at the same plant in July, 1920. They did not get the manganese as high as it should have been, both heats ranging between 1.05 and 1.10. The rails from these heats did not last in the track long enough to develop transverse fissures.

In January, 1921, the Lackawanna Steel Company rolled two more heats. The carbon and manganese of the two heats in question was 0.64 and1.34 and 0.57 and 1.34, respectively. The tests on both heats showed up very poorly. Therefore, I did not expect good results from this steel. As a matter of fact, both heats had to be removed from the track within less than three years on account of the development of an excessive number of transverse fissures.

I have given you these facts in order that all concerned may know that increasing the manganese and reducing the carbon will not necessarily either postpone or eliminate transverse fissures. The members of the Rail committee will remember the discussion which took place on this question of higher manganese and low carbon at the joint meeting with the manufacturers' committee on September 14, 1920. At that meeting there was a free discussion and at my request the Bethlehem Steel Company consented to roll 2,000 tons of this rail for test. This rail was rolled in September and October, 1920. The officers and employes of the Bethlehem Steel Company took great pains in rolling this tonnage of special steel. Mr. Bent deserves especial credit for his interest and assistance in making a success of all of the rollings made by the Bethlehem Steel Company. As a result of this care, the first 2,000 tons proved to be first class rail in every respect. The tests at the time of the rolling showed up remarkably well, and the rail has since shown up well under our traffic. In this 2,000 tons of steel no failures have occurred with transverse fissures and the rail is still in the track. It was on the strength of this test rolling that we arranged with the Bethlehem Steel Company to roll a considerable tonnage of this rail in the fall of 1924 and again this past year.

I am inclined to believe that this steel, when carefully made, will give good service. From the tests we have made to date, I have hopes that carefully made steel rail with manganese between 1.30 and 1.50 and carbon 0.60 to 0.70 will wear well and probably postpone the development of transverse fissures to a later date than we must expect with high carbon rail.

[E. E. Adams (U. P.), sub-committee chairman, presented the revised specifications for spring washers shown as Appendix A to the report; recommended design for track bolts, including corresponding joint bar punching, shown as Exhibit A.]

E. E. Adams (U. P.): Since the compilation of Exhibit A we have received a request from one of the railroads using the oval shoulder with the elliptical or oval head that we include 1 in., 1⅛ in. and 1¼ in. bolts. This will be done.

I move that the design for track bolts submitted in the report in Exhibit A be accepted for inclusion in the Manual. Motion carried.

Mr. Adams: The Specifications for Spring Washers has been revised to include both the helical and the elliptical spring washers. The committee recommends the adoption of this specification as standard for the Association, and I make a motion to this effect.

R. B. Jones (C. P. R.): I cannot agree that the specifications should be included in the Manual. There appears to be distinct conflict between certain clauses. Clause 8 indicates that the object of these 10 applications is to eliminate permanent set. Clause 16-a provides that previous to being offered for inspection each individual piece shall have been subjected as a part of the routine manufacturing process to shock or pressure sufficient to eliminate permanent set. If the permanent set is eliminated during the routine process of manufacture, what is gained by the 10 successive applications of the preliminary load? If it is not so eliminated, why specify that it shall be eliminated?

In the table of preliminary and test loads for the different sizes of washer the preliminary load for the low spring pressure washer is given as "Down to solid." What does this mean? If maximum micrometer thickness is intended, then "Down to solid" is not the way to express it. I have had occasion to test washers that were normally classified as helical low spring washers, and it is a very difficult thing to determine when the washer is down to solid.

Elliptical washers and helical low spring pressure washers are each required to pass the test for reaction, that for elliptical washers being definitely stated and that for helical low spring pressure washers being indefinitely indicated. Helical high spring pressure washers, however, are not required to meet any reaction test. Why should not the reactive value of all spring washers be determined in a similar manner?

We are interested in the reaction obtained at some stage of looseness of bolts that develops from what we may call static position when the man tightens the nut with the wrench. There is progressive looseness developing due to wear at that time, and I am interested to know what the pressure will be when the joint is in position.

There is no assurance that the preliminary load will compress the washer to the so-called test height of maximum micrometer thickness plus .02 in. A washer may be so manufactured that it cannot be compressed to within .02 in. of its maximum micrometer thickness by the high spring pressure preliminary load. Such a washer need have no spring action whatever, yet it would pass these specifications.

The committee may be satisfied that the specifications will include such spring washers as it is desired to purchase, but unless it can be demonstrated that they will also exclude such washers as it is desired not to purchase, I submit that they should not receive the stamp of approval from this Association.

J. B. Emerson (Engr. Tests A. R. A.): The chairman asked me to comment on the apparently very just criticism. In clause 16 (a) we have endeavored to make it compulsory that the manufacturer shall put all the routine product, each and every piece thereof, through a perfect routine jigging test, which is supposed to eliminate permanent set in the washers to any degree which would materially affect their reaction.

Under clause 4 we subject each test specimen 10 suc-

cessive times to the preliminary loads in order absolutely to insure that the specimens which we have under test are free from any set which might or might not have been successfully accomplished by the routine manufacturing operation which will show up right away on the difference in the height of the washer.

First, it shows whether or not the other requirement of specification has been met, and, second, it insures absolutely the relative integrity of the test itself, which is necessary, as we measure the acceptance or rejection of washers by a definite height which must be measured to hundredths of an inch and preferably to thousandths of an inch, since the washers are calibrated for maximum thickness to thousandths.

The preliminary loads which are stipulated in this specification invariably flatten the high spots down to approximately the same thickness.

On the low pressure washer, we used the same reserve factor over the maximum micrometered height for determining whether or not it has met the requirements of the specification.

Again, I might say for the committee in regard to the statement in Clause 6 of a reaction requirement for the elliptical spring, in the absence of a requirement for reaction for elliptical spring washers, the committee very strenuously sought a reaction requirement for the high pressure helical spring washers which could be commercially met by the manufacturers. I believe that the helical spring washer is different in principle and application from the elliptical spring washer. There admittedly is not as much reaction with spring pressure in the high pressure helical washer as there is in the lower pressure elliptical washer. The situation is that in order to gain pressures up as high as 40,000, 50,000 and 60,000 lbs. the surfaces will be held in such close contact that but little abrasion will follow between the respective surfaces and consequently the need for take-up is not so great, while in the lower tension washer in which the surfaces are not held so rigidly in contact more wear will result.

Mr. Jones: In connection with the last statement that the high pressures of these high pressure helical spring washers in themselves will keep the joint tight and minimize wear by keeping it tight, I submit that it is perfectly obvious that the only tension you can have in a track is the tension which you develop in it by the action.

If you give a man a joint to assemble he will assemble this joint and put the washer on and he will wrench up his joint just exactly like he has always done it, whether he has a low pressure helical washer or a high pressure washer. The maximum size of a helical spring washer has a high spring pressure load of 45,000 lb. I don't think that you can ever put 45,000 lb. tension in a track bolt. It may be something the washer can do, but it is not necessary to the service. I submit the correct method of testing any washer is for the committee to tell what the normal pressure is that that washer may be expected to start working from in the track, specifying a reaction in distance from that pressure and specifying a load and the compression which the device will develop on that reaction.

[*The motion made by Mr. Adams was carried unanimously.*]

[The report on mill practice and rail failures was presented by J. B. Emerson.]

L. J. F. Hughes (C., R. I. & P.): The full benefit of general statistics on rail failures is only realized when such statistics have been carefully studied and compared with similar statistics for the individual roads. To this end I have gone through the rail failure reports made to the A. R. E. A. by the Rock Island and have compared these results with the average conditions of railroads throughout the country, as reflected in the report of this committee. It would seem that our road is obtaining a very high quality of rail, for in every case the failures have been from one-half to one-third as great as the average for all roads in the country. But such is not the case. These rail failure statistics of the committee do not take into consideration the amount of traffic to which the rails have been subjected, and until some scheme has been devised which will reflect properly the influence of traffic on rail failures little benefit can be obtained by comparing performance on individual roads with the average for the entire country.

The effect of traffic on rail failures can be illustrated from the record of two equal lots of rail laid on our road in 1913. In that year we laid approximately 90 miles of 100 lb. rail and 90 miles of 90 lb. rail. At the end of 5 years the 100 lb. rail had 53 failures per 100 miles and the 90 lb. rail had only 7 failures per 100 miles. Both lots of rail were rolled at the same mill, during the same month and under the same specification. At the end of 1925, after 12 yr. service, the 100 lb. rail shows 268 failures per 100 miles, and the 90 lb. rail 90 failures per 100 miles. The answer to the big difference in the number of failures is that the 100 lb. rail has carried 110,220,000 gross tons traffic and the 90 lb. rail only 56,970,000 gross tons.

C. R. Harding (S. P.): The Southern Pacific went to considerable pains to determine the tonnage of traffic passing over failed rails. The results were disappointing. In the matter of failed rails there are other factors such as the curvature to be taken into consideration. Whenever we have looked into the problem from the question of curve versus tangents, we have found that had a great deal more to do with it than the tonnage which had passed over it. Furthermore, the type of power used on the district has a large influence. We have had rail that has been in the track 30 years. The accumulated tonnage is very great but the failure rate is small in proportion to the other rail which has been in service under heavy power and carried less total traffic. The question is so involved that the matter might as well be considered on a simple basis for comparative purposes.

[Chairman Moore presented the report on Transverse Fissures.]

Mr. Moore: The Rail Committee has compiled the data and information which was promised for a joint conference with the Department of Commerce under the direction of the Bureau of Standards. This information is now being forwarded to the Bureau.

[A progress report on the Relation of Bolt Tension to Mechanical Strength of the Joint and Rail Battering was presented by Hunter McDonald (N. C. & St. L.)]

[The subject of Welding of Traction and Signal Bonds was presented by Mr. Adams.]

E. E. Adams (U. P.): The committee reports progress but is not ready to make recommendations concerning the relation of the stresses in track to the change in rail structure.

[The report was accepted as information.]

J. B. Emerson presented the report on the Use of Girder Rails.]

Mr. Moore: *I move that the specifications for girder rails be adopted and printed in the Manual. Motion carried.*

[The committee was excused with the thanks of the Association.]

Progress Report on Stresses in Railroad Track

The Special Committee on Stresses in Railroad Track, co-operating with a special committee of the American Society of Civil Engineers, described its activities during the past year, consisting of experimentation on joints in track, as well as experimental work in the laboratory under carefully controlled conditions, which it is thought will have an important bearing on the design of the form of rail joint and on the analysis of its action under load. Field tests were conducted on tracks of the Illinois Central, the Delaware, Lackawanna & Western, and the Nashville, Chattanooga & St. Louis, and progress has been made in preparing the data. Professor A. N. Talbot has been chairman of this committee and of the committee of the American Society of Civil Engineers.

A. N. Talbot
Chairman

DURING 1925 experimentation was directed on the rail joint in an effort to determine the intensity and distribution of the stresses in the splice bar and in the rail at the joint, the characteristics of the flexural action for different forms of splice bar, and the effect of varying conditions in the joint, such as the tension of the bolts and the fit of the splice bar to the rail. An effort was also made to learn to what extent the stresses and moments varied from joint to joint in the track and whether the joints in service behaved in accordance with assumptions quite commonly made.

The experimental work in the laboratory under controlled conditions permitted the measurement of the strains in the various parts of the angle bar or other form of splice bar under bending loads, the measurement of the tension of the bolts tightened under different degrees of torque and the effect on the corresponding flexural stresses in the splice bar, and the observation of the position of the bearing areas and the effect of the fit of the splice bar against the rail and also the effect of the vertical deflection and play of the splice bar and of its lateral bending and twisting. It has given information which it is thought will have an important bearing on the design of the form of the splice bar and on the analysis of its action under load.

Field tests were conducted on the track of the Illinois Central at Champaign, Ill.; the Delaware Lackawanna & Western at Dover, N. J., and the Nashville Chattanooga & St. Louis at Bass, Ala. The rail was 90-lb., 130-lb. and 110-lb. The joints were tested as found in the track, loads of from 95,000 to 127,000 lb. on a four-wheel truck of a freight car being applied and also in some tests lighter loads. Measurements were made of strains at certain gage lines on the splice bars and rails, tension in the bolts and deflections at the joints and for given distances on each side of the rail end. Although the nature and extent of the tests differed at the three locations, the following may give an idea of the variation in the conditions of the tests: tight and loose bolts, tightness of bolt obtainable by track wrench in the hands of track man, loose tie and freshly tamped tie, good and bad fit of angle bar, special forms of angle bar, and relative tension in bolts at joints where rails had been slipping with changes in temperature and at joints that had not moved under the same conditions of temperature.

Progress has been made in reducing data and preparing the material, but the work is not yet ready for presentation. It is found that the resisting moment developed in the joint under load in the track varies greatly from joint to joint and an effort is being made to learn the principal sources of this variation. As may have been expected from analytical considerations, the neutral axis of the angle bars deflects from the horizontal and the stresses at the outer edge of the flange of the angle bar are frequently very low, especially with loose bolts or poor fit between bar and rail. In several ways the results may be expected to lead to a discussion whether improvements in the design of the rail joint may be made.

Committee: Arthur N. Talbot (U. of Ill.), Chairman; W. M. Dawley, (Erie), Vice-Chairman; G. H. Bremner (C. B. & Q.), George W. Kittredge, (N. Y. C.), C. B. Bronson (N. Y. C.), Paul M. LaBach (C. R. I. & P.), John Brunner (Ill. Steel Co.), C. G. E. Larsson (Am. Bridge Co.), W. J. Burton (M. P.), G. J. Ray (D. L. & W.), Chas. S. Churchill (N. & N.), AlbertReichmann (Am. Bridge Co.), W. C. Cushing (Pa.), H. R. Safford (G. C. L.), C. W. Gennet, Jr., (Robt. N. Hunt Co.), Carl Stimson (B. & O.), H. E. Hale (Pres. Conf. Com.), F. E. Turneaure (U. of Wis.), J. B. Jenkins (B. & O.), J. E. Willoughby (A. C. L.).

Discussion

[The report of the special committee on Stresses in Railway Track was presented by Professor A. W. Talbot, chairman.]

Prof. Talbot (Univ., Ill.): The work of the committee for the past season has been on the subject of rail joints, not particularly the strength of these joints but how they act when connected up with a rail, both in the laboratory and the track, in matters of stiffness as well, and lateral movement and twisting which would affect whether the track could easily be kept in condition.

Measurements were made of the strains in different parts of the splice bars, angle bars and other standard forms of joint bars and of the tension of the bolts. It is interesting, I think, to note that the tension in the bolts found in tracks on three different railroads, the Illinois Central, the Nashville, Chattanooga & St. Louis, and the Delaware, Lackawanna & Western, showed considerable variation, even on the same joint. The variations were from a very loose bolt to stresses of 40,000 lb. or more, and in the same bar on several of these roads, not just on one or one joint, from 4,000 to 20,000 lb.

It has been found that when the load is at the joint, the stress at the outer edge of the flange of the angle bar is very small and sometimes may be even compression instead of tension. The stress at the top of the bar, being in compression, is higher at this point and this, of course, will have the same general effect when the negative moment is put into the joint.

I might add just for general information that with the angle bar joint and the load at the ends of the rail, the intermediate bolts loosen somewhat and the end bolts tighten, and that the angle bar at its middle moves inward somewhat at the bottom and at the bolt; that is shown when it is tightened and the movement is measurable, while at the end the movement both at top and bottom is outward. The unsymmetrical section is the cause of this. If it were not held, the analysis of the matter shows that there would be this twist.

[The committee was dismissed with the thanks of the Association.]

American Railway Engineering Association Registration

A TOTAL of 229 members and 55 guests registered at the convention yesterday bringing the registration of members for the two days to 783 and the guests to 177, a total of 960. This compares with a total registration of 942 for the first two days of last year. The registration follows:

Alden, C. A., ch. engr., Frog & Switch Dept., Bethlehem Steel Co., Steelton, Pa.
Anderson, Anton, engr. main. of way, C. I. & L., Lafayette, Ind.
Anderson, J. P., div. engr., N. C. & St. L., Atlanta, Ga.
Armistead, F. W., asst. engr., I. C., Chicago.
Backes, W. J., engr. main. of way, B. & M., Boston, Mass.
Bainbridge, C. N., engr. of design, C. M. & St. P., Chicago.
Baker, W. E., sup., Penna., Cleveland, O.
Bakhshi, S. R., asst. engr., C. B. & Q., Chicago.
Baldwin, Hadley, ch. engr., C. C. C. & St. L., Cincinnati, O.
Baldwin, R. A., dist. engr., con., C. N., Toronto, Ont., Can.
Barrett, P. T., of. engr., C. & W. I., Chicago.
Bartlett, Calvin, real estate agt., Wabash, St. Louis, Mo.
Baxter, J. J., asst. ch. engr., Wabash, St. Louis, Mo.
Bayer, E. J., engr. main. of way, P. & E., Indianapolis, Ind.
Billman, H. E., con. engr., St. Louis, Mo.
Blanchard, A. M., pilot engr., val. dept., C. N., Toronto, Ont., Can.
Bohland, J. A., bridge engr., G. N., St. Paul, Minn.
Bond, L. H., engr. main. of way, I. C., Chicago.
Bradley, A. C., div. engr., C. R. I. & P., Rock Island, Ill.
Breed, Chas. W., engr. of standards, C. B. & Q., Chicago.
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Bryant, C. T., asst. div. engr., C. C. C. & St. L., Springfield, O.
Buck, J. A., sup., Wabash, Forest, Ill.
Burnett, W. S., ch. engr., of con., C. C. C. & St. L., Cincinnati, O.
Burpee, G. W., Coverdale & Colpitts, New York City.
Burrell, Chas. F., engr. main. of way, K. & I., Louisville, Ky.
Burt, J. W., div. engr. C. C. C. & St. L., Indianapolis, Ind.
Butterworth, A. S., div. engr., St. L.-S. F., Pensacola, Florida.
Carpenter, R. H., draftsman, M. P., St. Louis, Mo.
Carpenter, Wm., gen. foreman in chg. track main., B. & O., Chicago.
Carrick, O. W., water engr., Wabash, Decatur, Ill.
Carter, H. K., asst. div. engr., C. C. C. & St. L., Mattoon, Ill.
Cast, W. B., val. engr., K. C. T., Kansas City, Mo.
Causey, W. B., v. p., M. E. White Co., Chicago.
Chamberlain, O. P., v. p., Dolese & Shepard Co., Chicago.
Charleson, C. W., asst. engr., C. B. & Q., Lincoln, Neb.
Cheney, B. M., Laughlin & Cheney, Inc., Chicago.
Chipman, Paul, of. engr., P. M., Detroit, Mich.
Clark, A. M., div. engr., N. Y. C. & St. L., Ft. Wayne, Ind.
Clark, H. G., asst. to pres., C. R. I. & P., Chicago.
Clarke, H. S., engr. main of way, D & H., Albany, N. Y.
Coates, F. J., supr. track, I. C., Dyersburg, Tenn.
Cowsert, John M., sup. water dept., M. P., Gorham, Ill.
Craine, Lawrence, asst. engr. val., M. P., St. Louis, Mo.
Cramer, W. N., track supr., I. C., Freeport, Ill.
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Culp, C. B., asst. engr., C. & W. I., Chicago.
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Davidson, G. M., ind. engr., C. & N. W., Chicago.
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Dorrance, W. T., designing engr., N. Y. N. H. & H., New Haven, Conn.
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Coln, W. R., roadmaster, C. R. I. & P., Brinkley, Ark.
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Phillips, T. G., Reading, Philadelphia.
Poffenberger, J. C., supvr., Penna., Columbia, Pa.
Pollak, F. A., asst. engr., St. L. S. F., St. Louis, Mo.
Powell, L. H., asst. engr., A. T. & S. F., Chicago.
Robbins, H. W., Chicago.
Rohr, E. J., sup. b. and b. and track, Cincinnati, O.
Sato, C., Japanese Govt. Ry., New York.
Seabury, G. T., sec., American Society Civil Engineers, New York City.
Smith, H. R., asst. engr., P. M., Detroit, Mich.
Sparks, W. H., insp. track, C. & O., Russell, Ky.
Stone, B. H., chem., C. R. I. & P., El Reno, Okla
Takahashi, S., Japanese Govt. Ry., Tokyo, Japan.
Theodorsen, W. A., Chicago.
Van Auken, C. L., v. p. and man. editor, Electric Traction, Chicago.
Yocum, A. H., sig. engr., Reading, Philadelphia, Pa.
Williams, V. H., asst. engr., A. T. & S. F., Chicago.
Zeeman, M. J., asst. engr., A. T. & S. F., Chicago.

A. R. E. A. Elects New Officers

Report of tellers announced at close of Wednesday afternoon session—C. F. W. Felt president-elect

PRIOR to the adjournment of the afternoon session yesterday Secretary Fritch presented the report of the tellers who had canvassed the ballots for officers as follows:

President, C. F. W. Felt, chief engineer system, A. T. & S. F.

Second Vice-president, W. D. Faucette, chief engineer, S. A. L.

Treasurer, George H. Bremner, engineering department, C. B. & Q.

Secretary, E. H. Fritch.

Directors: L. W. Baldwin, president, Missouri Pacific System; R. H. Ford, assistant chief engineer, C. R. I. & P.; Frank Lee, engineer maintenance of way, C. P. R.

Nominating Committee: L. B. Allen, superintendent maintenance of way, C. & O.; A. F. Robinson, bridge engineer system, A. T. & S. F.; E. R. Lewis, principal assistant engineer, M. C.; C. W. Baldridge, assistant engineer, A. T. & S. F.; and W. H. Hoyt, chief engineer, D. M. & N.

In addition, D. J. Brumley, second vice-president, automatically becomes first vice-president.

D. J. Brumley
First Vice-President

C. F. W. Felt
President

W. D. Faucette
Second Vice-President

Charles F. W. Felt, President of the American Railway Engineering Association

The election of Charles F. W. Felt as president of the American Railway Engineering Association brings to the head of that body one who has been a member of the association since its organization and who has always taken an active interest in its behalf. Even at the first annual convention, Mr. Felt was instrumental in interesting a number of his associates in the new organization and in inducing them to attend.

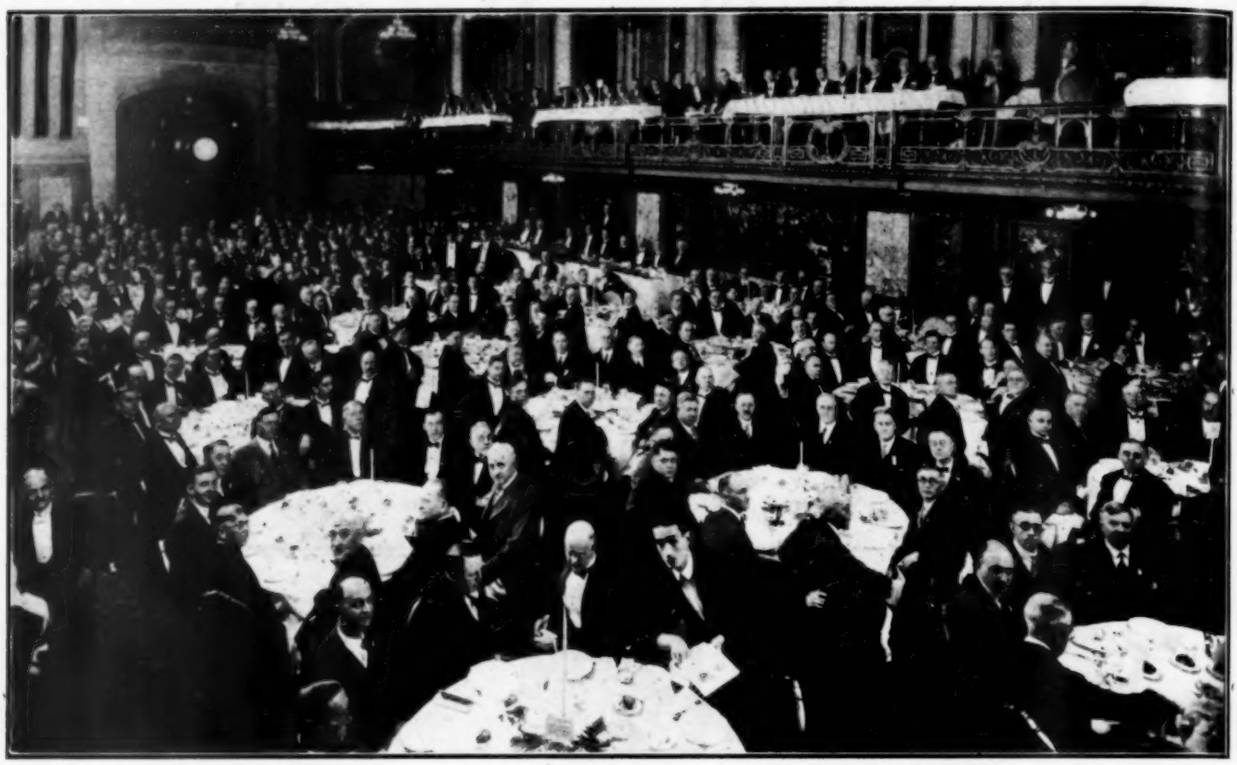
Mr. Felt's activities in the association have always been characterized by constructive work. He was a member of the Board of Direction from March, 1921, to March, 1924, inclusive, being elected second vice-president in 1924, and first vice-president in 1925. He has been a member of the Committee on Rail since 1922 and in 1923-1924 was chairman of the sub-committee which participated with the Bureau of Standards in a joint investigation of transverse fissures.

As a citizen Mr. Felt has always identified himself with the best elements in the communities in which he has lived with the result that he has a wide circle of friends over a large section of the country. He is a member of the Chicago Engineers' Club, of which he is a past president, and of the Western Society of Engineers, which organization he has served in various capacities, including that of vice-president.

Mr. Felt's career emphasizes the value of strict attention to the work in hand, a keen, analytical mind quick to grasp and retain detail, and consideration for his associates and subordinates, thus inspiring loyalty and insuring co-operation. In keeping with this latter trait, Mr. Felt has taken a deep interest in the Railroad Y. M. C. A. ever since its inauguration on the system with which he is now the chief engineering officer.

Born in Massachusetts, Mr. Felt was educated at the Massachusetts Agricultural College and entered railroad service in 1886 as an axman on construction on the Atchison, Topeka & Santa Fe in Kansas with which system he has since been identified with the exception of about four years from 1888 to 1892, when he was employed in the engineering departments of various roads in the western and southwestern portions of the United States and Mexico.

Returning to the Santa Fe in 1890, he became a division engineer on the Gulf, Colorado & Santa Fe, and thereafter was successively resident engineer, chief engineer of that road and chief engineer of the eastern and western lines of the Atchison, Topeka & Santa Fe. Since 1913 he has been chief engineer of the Atchison, Topeka & Santa Fe System.



Members of the Association and Their Guests at the Annual Dinner Last Evening

Annual Dinner Attracts Record Crowd

Gold Room unable to accommodate those desiring to attend, forcing overflow into adjoining rooms

APPROXIMATELY 800 members and guests of the American Railway Engineering Association gathered in the Congress Hotel for the annual dinner of the association last evening, filling the Gold Room to capacity and overflowing into adjacent rooms, this being the most largely attended dinner in the history of the association. A special feature of the dinner was a replica of the front end of a large locomotive emerging from the Connaught tunnel in the Canadian Selkirks, which was mounted in one end of the hall and which carried the number 2300, indicative of the total membership of the association. The dinner was opened by "Bringing in the Haggis," with a bagpiper and the full Scotch ceremony.

J. M. R. Fairbairn, president of the association, acted as toastmaster. Mr. Fairbairn introduced as the first speaker E. W. Beatty, chairman and president of the Canadian Pacific System, who spoke on The Engineer. Following this address Mr. Fairbairn introduced Dudley F. Holtman of the United States Department of Commerce, who spoke on What Wood Utilization Means to the Railroads. The program was brought to a conclusion by an address by Rev. Allen P. Shatford, canon of the Church of St. James the Apostle, Montreal, Que., who selected as his subject Bringing the Nations Together, treating the subject with a deep sense of humor, which added much to the interest of the program. The addresses of Mr. Beatty and Mr. Holtman are published below.

The Engineer

By E. W. Beatty
President, Canadian Pacific Railway

ANY one who undertakes to make an after-dinner speech to a group of engineers does so at a considerable disadvantage. For according to the manuals on after-dinner speaking, the correct procedure is to begin with a humorous anecdote which has particular reference to the audience one addresses. But on referring to the standard collections of humorous anecdotes for such occasions, I find that while there are highly entertaining stories about such classes of the community as actors, artists, authors, bankers, barbers, bootleggers, clergymen, dentists, doctors, farmers, musicians, politicians and even undertakers, I cannot find any such stories quoted as suitable for a gathering of engineers. For lack of any such humorous anecdote about your otherwise distinguished calling I therefore turned to a serious work of reference which is popularly supposed to contain all the

wisdom of all the ages—I refer to the Encyclopedia Britannica.

There to my surprise, and also to my dismay, I found that the learned authorities who compiled that monumental work have devoted to the subject of "engineering" only half a column, whereas three whole pages are given over to the subject of "witchcraft" and no less than eight to that of "football." Moreover, in none of these three articles, namely, "engineering," "witchcraft" and "football" is there any reference to the American Railway Engineering Association. I hope your President will see to it that this omission is rectified in the next edition of the Encyclopedia in question. I find myself in the meanwhile the horns of a dilemma. Either this audience which I see before me is not worthy of much consideration or else the Encyclopedia is wrong.

Personally, I think the latter theory is correct, namely, that the Encyclopedia is ill-informed. But if it is ill-informed, there is probably a very good reason, and the reason that springs to my mind is that

E. W. Beatty

the engineering profession has not sufficiently asserted itself, has not adequately advertised its importance to the world at large.

Constructive Work of the Engineer

It is a very great pleasure and honor for me to attend this dinner of the members of the American Railway Engineering Association, and it is particularly so because one of our own officers is your president. As a Canadian and as a fellow officer of the Canadian Pacific Railway Company, I congratulate him on the distinction you have conferred upon him. As a boy I had a great ambition to be an engineer. My mother wanted me to be a minister and my father, a doctor, so naturally I became a lawyer. The kind of engineer I wanted to become was not that associated with most boys' ambitions—the driver of an engine—but a man who constructed things. No profession of which I am aware has that opportunity of leaving behind it physical achievements as does the profession of engineering. In my peregrinations around the country, which are somewhat extensive, I never see a bridge or a tunnel of conspicuous proportions or difficulty in construction, or a viaduct, that I do not feel that any man should be proud that he created, erected or constructed such a work and left behind him one or many, as the case may be, concrete evidences of his own achievement.

This is not to be wondered at when you consider that no matter how able he may be, few men are permitted to leave behind them evidences of their own work which may be pointed to by future generations as a great conception or a great execution. My appreciation of engineers is not confined to that negative recognition they receive as gentlemen well versed in the science of underestimating and overexpending which seems to be part of my daily diet with them, but because of the fact that the inspiration to become an engineer involves certain characteristics which we all admire. Any man who voluntarily takes up engineering because it appeals to him is rarely anything else but a strong, virile member of the male sex who is not afraid to match his strength and ability against the forces of nature and implicitly believes in his power to overcome them.

If a properly conceived Encyclopedia were to be compiled of the Dominion of Canada and the United States, my own thought is that one of the most important articles would be devoted to the immense contribution made by engineering to the development of our countries. Without the engineer, we should still be in the wilderness stage, whereas the vast territory from the Atlantic to the Pacific is netted with roads, railways, canals and telegraph wires; we have safe and well equipped harbors linked with Europe, the Orient and Australasia by large fleets of ocean-going steamers; our mineral and forest resources are being successfully exploited; our farms are operated with the most up-to-date machinery; our cities are built, paved, drained and lit with electricity as any modern cities should be, and we have industrial centers humming with factories of every conceivable kind. In fact, within the last half century, the North American continent has grown to be as much an industrial and commercial as an agricultural country, and for this the engineer is largely responsible.

The astonishing thing is that this transformation has been directed by so few men. In a report which I read recently, the report of an address delivered by Professor C. R. Young to the Toronto branch of the Engineering Institute of Canada, I noticed the statement that there were just 12,000 men holding engineering positions in Canada, and the fear was expressed that the universities are turning out too many qualified engineers for the country to absorb. To my mind the answer should be that if so small a body of men has achieved and is continuing to produce so vast a transformation, the greater should be our endeavor to find employment and opportunity for all the men of that type that the universities can turn out.

Value of Engineering Education

My own personal training was initially a legal training, and I might be considered as prejudiced in favor of lawyers, but I cannot conceive that Canada would be as pleasant a place to live in as it is if its development should have been left to the tender mercies of twelve thousand lawyers. The inference we should draw is that the more engineers we can keep employed, the better for the material progress of the country. It is, however, not altogether correct to credit the whole of this progress and development to the professional engineer. These professional men have been in many instances rather the instruments than the inspirers of the development. But even among the other classes of the community which have actively contributed to this development you find the technically trained men in the forefront. In all our indus-

tries and in a great many of our commercial enterprises it is the technically trained man who is pushing to the front. A man who has been through an engineering course understands the machinery of his business, is practical and can adapt himself to ever changing conditions.

If I were to be asked what is the most characteristic quality of the Canadian and American of today, I should answer that he is practical. I think this characteristic should be taken into consideration by our educators, who are always preaching to us that the best education is that which develops a natural bent. To my mind there could be no better training for a practically inclined youth, whatever his ultimate calling may be, than a course in engineering. He need not take that course with a view to becoming a professional engineer. But he will find that course of substantial value in nearly every kind of business—even a lawyer would be none the worse for it—particularly when that business is concerned with manufacturing or the operating side of any industry. And our employers would be wise to remember that the technically trained man is the most practical and adaptable kind of employee or officer he can get.

Engineers in Transportation Service

I am often asked why we do not find men with engineering training occupying positions in transportation and other similar corporations. Now, as you know, this bald statement is not accurate that in a great many railway companies men of your profession are found in great numbers, not only in the engineering departments but transportation departments, but it is also true that in other companies, and I think this applies to practically all Canadian companies, engineers except those carrying on their profession within the ranks of the corporation, are a very small percentage of the companies' officers.

One would naturally think that a young man, well educated, of good physique and trained in engineering, would be attracted to railway work, and the only explanation I can make is one which applies to all college men in large businesses. Universities can give a man much. They can give him the rudiments of knowledge, they can teach him to think logically and correctly, they can teach him to study but they cannot make him anything. That is a responsibility he must assume and a result which he can only accomplish himself.

Now, one of the difficulties confronting large corporations—and you can take it as admitted that all corporations now admit the value of educated men in their service—is the acknowledged attitude of the college graduate towards work. By reason of his advantages in education, the young man leaving college is apt to think he is equipped to be an officer or for some superior position without going through the arduous work of apprenticeship. No impression could be more erroneous. The most intelligent college graduate begins his practical work at a disadvantage compared to a man of the same age who has had, let us say, five or six years practical experience. The virtue in education is that it enables a man to overcome that disability, and ten years later the advantage is all with him. A college graduate who is prepared to start at the bottom instead of in the middle or at the top will make rapid progress in transportation service but he must start at the bottom and he must have the mental attitude that puts work—hard and intelligent work—before every other consideration.

With these principles admitted, the members of the engineering profession are the most likely recruits to transportation service and who become very valuable officers. Of course, to me railroading has always been a very fascinating game. It has its disadvantages. It is exacting. The remuneration a man may obtain is certainly no more and often much less than he can secure in other walks of life, but then all salaried men labor under that disability. He has this assurance, however, that if his office is important enough his salary is at least commensurate with it, and he will soon appreciate that a benevolent government will see that he is not permitted to retain more than a part of it for his own purposes.

Need of Technically Trained Men in Business

In my earlier remarks I suggested that the engineer had not sufficiently asserted himself, had not adequately advertised his value to the community. If I have any message to bring to you tonight, it is this, that you should, by constant propaganda, make the employers of your country realize that the technically trained man is the man they need in their business, whatever that business may be. You may have to bring pressure on universities to broaden the curriculum in the Engineering School so as to give more attention to engineering economics and business administration. That is being done now by Harvard and other American universities, and is being considered as a possible move by McGill University, provided it meets with the support and approval of the engineering profession.

One great work of the engineer has been to reduce the cost of production. A still greater work has been to reduce the cost of distribution by minimizing the factor of distance. Incidentally also the engineer has enormously increased the possibility of employment and therefore has enlarged the markets and increased the number of possible consumers. A course of education on these facts distributed to the farmers of this country will do much to modify the antagonism which unfortunately still prevails between the agricultural prairies and the industrial east.

I come from a country whose development must almost inevitably be along the lines of the development of these United States, which enjoys the same democracy of institutions which prevail here though slightly different in form, a country whose people have lived with you in the closest harmony and the deepest mutual respect, whose three thousand miles of border line are unprotected except, of course, by high tariff walls, and the interchange of whose population is so free and unrestricted that even bootleggers move backwards and forward with relative unrestraint. Canada, as you know, is almost equal in area to your own country, and it has been described as the largest undeveloped country in the world. After one hundred years of settlement, its population only equals the increase in your population in the short span of fifteen years, and after that period it still contains about the same number of people as are resident in the cities of New York and Chicago. It is a country of great potentialities and much natural wealth, and these potentialities and this wealth we expect to realize upon in the not very distant future. Like you, it has had transportation problems—serious problems which it is endeavoring to settle in its own way. It has two huge transcontinental systems, each under single administration extending in theory and in fact from the Atlantic Ocean on the east to the Pacific Ocean

on the west, an achievement the parallel of which even the great United States cannot claim to have accomplished.

A Great Transportation System

I represent a company which is the pioneer transcontinental system of Canada and is just forty years of age. In conception and execution it was a national enterprise, though it has always been permitted to enjoy the blessings of private administration. Its construction made the confederation of the Canadian provinces possible, and it and the companies which have succeeded it have been the largest single factor in Canada's development thus far. It is a large undertaking even in these days of mergers and amalgamations, being in control of twenty thousand miles of railway in Canada and the United States, with fleets on both Oceans, a hotel system consisting of fourteen modern hostelries, mines, smelters, agricultural lands, mills, timber limits and townsites, and doing business in every civilized quarter of the globe.

While we feel proud of it as a distinctly Canadian achievement, we are not unmindful of the fact that its support in earlier days came from England and Scotland, and to some extent from the United States, and that while reciprocity in goods has not existed between this country and Canada, reciprocity in man-power has, with the result that the second and third presidents of the company were drafted from the United States and that one of our incorporators was a Canadian who afterwards helped to make American transportation history, the late James J. Hill.

The second president of the company was Sir William Van Horne, and the third, Lord Shaughnessy. Van Horne came from the town of Joliet, in this state, and Shaughnessy from Milwaukee. Both of them were honored by their sovereign for distinguished public services. Ven Horne being made a knight, and Shaughnessy being raised to the peerage. In the jocular language of an American newspaperman of that day, "He was the peer that made Milwaukee famous."

I am to be succeeded by a very eminent gentleman from Montreal, the Reverand Canon Shatford, who, I understand, is to address you on the "Uniting Influences of the Railways in the Friendship of Two Great Peoples." I do not propose to anticipate what my friend, the witty and eloquent canon, will say to you, but in consonance with the happy parallels and the effective logic which he will no doubt develop in the course of his remarks, may I say a word as to what I regard as the two chief international functions of your association. Comprising among your membership the representatives of the engineering profession in railway work, a large part of your duty must consist in deliberations on practical and scientific questions in order that the efficiency of your roads may be increased and that the engineering methods and practices may be standardized to the advantage of the properties of all railways. These are the daily and sometimes stern problems which must of necessity engross your attention but beyond them are others not quite so material but equally important. You can make your contribution, and it is not an inconsiderable one, to the good will which exists between the peoples of these two countries, and you can make a still greater contribution to the dignity and honor of your profession.

Where the human element is involved, we who have some knowledge of railway operations knew that the liability for a mistake most readily exists and therefore the mutual support of members of one association in annual or semi-annual deliberations not only strengthens the professional bonds which already exist but increases the ability of the individual member to act according to the highest standards of his very outstanding profession. In the hurly-burly of modern business and the loose methods that speed provokes, the steadying influence of the standards of the men of your profession is very great, and if that is not maintained, engineers will suffer the same public disrespect as the quack doctor or the shyster lawyer.

The Spirit of Doing Big Things

As illustration of these standards, I am reminded of an incident in the life of Major Rogers, an American engineer who did notable work in the location of the Union Pacific Railway and who discovered for the Canadian Pacific Railway the pass through the Salkirk Range of the Canadian Rockies, which now bears his name. Like Van Horne, Major Rogers, although a practical, hard-headed business man, was inspired to his greatest efforts by the challenge of difficulties to be overcome, and the problem of finding a commercially possible railway route across this apparently insuperable barrier of giant mountain ranges was just what he loved. When after explorations involving severe physical hardships, his efforts were crowned with success, a bonus check for $5,000 was sent to him by the company. The story of what followed is narrated by the Rev. R. G. MacBeth in an entertaining historical volume entitled "The Romance of the Canadian Pacific Railway." The check was not cashed and Van Horne, when a few months later he met the engineer, reminded him of the fact, to which Major Rogers replied:

"Do you think I would cash that check? I was not out there for money, but to have a hand in a big project. No, sir, I have that check framed in my brother's house in Waterville, Minnesota, where my nephews and nieces can see it as a token of some work their old uncle did in his time."

Gentlemen, so long as the spirit of going big things for the sheer delight of doing them animates the human race, so long must we feel convinced that the world has not been created in vain. Such, I am convinced, is the spirit of the engineer who, while he very properly is not unmindful of the tangible rewards for his services, knows all the while that the finest of all rewards is the realization of great work well and truly done.

Wood Utilization and the Railroads

By D. F. Holtman

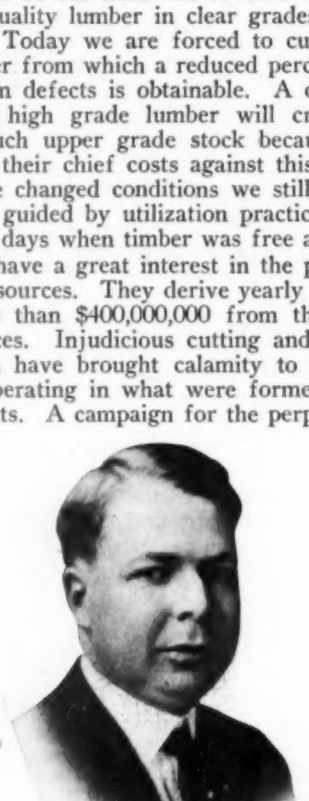
Assistant Director, National Committee on Wood Utilization, U. S. Department of Commerce, Washington, D. C.

PROBABLY no subject of public interest has been more consistently misrepresented than that of better wood utilization. Lumbermen have been continuously pictured as tree butchers, operating chiefly for the production of saw-dust and fires, whether in the mill burner or the forest. Most of us have complacently accepted this view and serenely lulled ourselves to sleep,

probably hoping that sometime, somehow, the problem of better wood utilization would solve itself.

Necessity is the mother of invention. Obviously there was no need of practicing forest thrift in the days when forty per cent of our land was covered with virgin forest. High quality lumber in clear grades was plentiful and cheap. Today we are forced to cut much second growth timber from which a reduced percentage of lumber free from defects is obtainable. A continued large demand for high grade lumber will create abnormal prices for such upper grade stock because lumbermen must charge their chief costs against this item. In the face of these changed conditions we still continue as a nation to be guided by utilization practices which originated in the days when timber was free and wild.

Railroads have a great interest in the perpetuation of our forest resources. They derive yearly a freight revenue of more than $400,000,000 from the products of those resources. Injudicious cutting and a low degree of utilization have brought calamity to many railroad companies operating in what were formerly prosperous timber districts. A campaign for the perpetuation of an



D. F. Holtman

industry which is as vitally connected with the railroads as the lumber industry is, should enlist the practical support of every individual connected with our railroads. The practical benefits that will result will affect the lives of all of our people, both now and in the future, for transportation touches the life of every citizen.

Better wood utilization generally throughout the country will increase the rail haul of forest products and have a direct positive effect upon revenues derived from this source. Much of the increased volume of freight business will be in finished or semi-manufactured articles instead of raw material, thus enhancing such revenues still further. At present, taking the country as a whole, only between 25 and 35 per cent of the standing tree is utilized. Better utilization will mean more building and construction; better equipment, and the employment of more men in railroad work.

A little more than a year ago there was held in Washington a conference of great national importance. That conference was called by the President. It was participated in by two important government departments—Agriculture and Commerce—and was attended by more than 500 delegates from all sections of the country, representing producers, distributors and consumers of wood in all of its forms. Herbert Hoover was appointed Chairman of the National Committee on Wood Utilization which grew out of the Conference. Colonel Greeley, chief forester, United States Forest Service, is the vice-chairman of that committee, which numbers in its personnel the leaders of the lumber industry and of all important organized wood using groups. The railroads are represented by R. H. Aishton, president of the American Railway Association.

The National Committee on Wood Utilization is an official committee, organized by the Department of Commerce at the direction of President Coolidge. Composed as it is of producers, distributors and consumers of wood and wood products, it expects to work in close co-operation with official and private organizations interested in any phase of the problem of better wood utilization. Recognizing that legislation never accomplished great economic or moral reform, it is through the instrumentality of education that this committee hopes to improve the wood utilization practices of the nation. By education it hopes to direct public attention from the obsolete idea that the way to conserve our forests is by *not* using forest products and to focus it upon the sounder and more reasonable doctrine already referred to and probably best expressed by the words, "Perpetuate our forests by more intelligent utilization of wood."

You come from every section of the country. By training and experience you are accustomed to be precise. And since it is precision of thought that is so greatly needed at this juncture in the national forest problem, it is encouraging to have this opportunity of laying before you our plans and our objectives at this early stage in the development of our program. Most of you—I dare say all of you—are trained engineers. You have spent at least four years of your lives developing the technique and theory which you now apply. During that period you probably learned little about lumber and timber. Lumber and its proper use was more or less taken for granted by everyone. The intricacies of concrete and steel construction, on the other hand, were delved into at much length and with great persistence. There is something about new things that attracts attention, and probably it was because reinforced concrete construction, particularly, was something new that so much time and study was given to its proper use in all classes of construction. Many of you have spent weary hours endeavoring to master the theory of reinforced concrete and structural steel design. And what was the natural result of that training? When you completed your course, you sought employment where you would be able to apply the knowledge you had gained. You satisfied your desire to work with materials that were familiar to you. Miles of reinforced concrete culverts, arch bridges, steel girders and trusses are the result of the practical application of your training.

It is natural for all of us to like to do the things we can do best. I hope, as our national program impresses itself upon the minds of the engineers of the country and upon the young men who will be the engineers of tomorrow, there will be developed a real zeal for the practical realization of this great utilitarian program that has the support of all elements of the trade. I hope you will learn to like to strive for better wood utilization on the railroads as you become familiar with the possibilities in this field.

Railroads are the largest industrial consumers of sawmill products and they are the pioneers in the use of treated timber. Though they have long recognized the economic value of treated wood, there still exists a need for the consideration of the relative economy of untreated versus treated lumber and timber construction, in many forms of railroad work. Wood preservation is an important phase of better wood utilization and its possibilities should be given the thoughtful consideration of all who are interested in producing greater economy

and efficiency in the operation and maintenance of our railroads.

The largest part of present day sawmill production consists of common grades of lumber for which there is not an active demand. In fact, most lumber producers must sell such stock at cost or even at a loss. A more uniform demand for all grades produced will encourage a closer utilization, enable the manufacturer to distribute his cost more equally on all grades produced, and stabilize the market for lumber and wood products as a whole. The saving to the consumer is apparent.

Tastes for certain species encountered in the early pioneer days still prevail. Every new forest area that is opened up reveals new and unfamiliar species of wood. Many of these species have qualities which make them eminently suited for certain uses, but there has been tremendous consumer resistance to their adaptation in practice. Before the war our gum found its chief market abroad. Europe had to discover it for us. Today gum is being widely used by our own industrial trade. Our West Coast forests of Douglas fir contain a large percentage of West Coast Hemlock. But until very recently, the merits of West Coast hemlock have been little known or appreciated by the lumber consuming public. As a consequence, the Douglas fir cut in this region has had to stand the loss which has resulted from inadequate markets for hemlock. Western larch and white fir are other outstanding examples of species which are little used, but which are important factors in the lumbering activity of America today. Instead of being left in the woods to decay and rot, these species that are cut during the general felling incident to any lumber operation must be used if we are to obtain the maximum utility from our remaining stands of virgin timber.

Another phase of any program aimed at better wood utilization must be the development of larger outlets for sap stained lumber. Failure to realize that there is nothing insidious about blue stained lumber is resulting in great losses, especially in those regions where small sawmills are numerous and where kiln drying cannot be profitably practiced. Blue stain is caused by a fungus which germinates in the sapwood and penetrates its cells in search of starches and sugars. This action of the fungus causes no perceptible weakening of the wood but the discoloration which results has lessened the appearance value of the lumber for many purposes, such as interior finish and flooring. Warm weather and a comparative high moisture content of the wood are the most favorable conditions for the growth of the blue stain fungus. Most of the infection occurs in green lumber which is piled without ample ventilation between the boards, either in the mill yard or during transit.

To the extent that a closer, more intelligent utilization of any raw material profits those who use the product; a general acceptance of blue stained lumber for use in locations where it is to be painted or in some other way covered up will result in more economical and lower cost construction. As large mills cut out and give place to the smaller units that invariably follow in the wake of large-scale production, there is bound to be an increasingly large quantity of blue stained lumber developed. When consumers realize that the only known method of preventing this stain is to kiln dry the lumber, and when they understand that the average small mill operation does not permit of investment in drying kilns, they will appreciate the responsibility for utilizing such stained stock which they must assume. Blue stain is not decay and it affects neither the strength nor durability of lumber. For those uses, therefore, where strength is a factor, blue stained lumber is just as good as bright lumber and should not be discriminated against, particularly when it is to be covered or in some other way hidden from view in the final structure.

Still another important phase of wood utilization is the handling of lumber and timber after it has been delivered to the railroad. Maximum results cannot be expected if the material is abused while stored and handled. Bearing this important fact in mind, information should be promulgated to the railway forces indicating specifically how the lumber and timber is to be stored, piled, handled and put to use.

One of the most troublesome obstacles to better wood utilization is the inherent desire of all those who buy sawmill products to insist upon long, even length material from which to obtain short, odd length lumber. This practice, born in the early pioneering area, results in one of the largest sawmill wastes. In an effort to meet the demands of the lumber consuming public, and provide long, even length stock, the lumber industry is forced to send to the burner vast quantities of lumber without flaw or blemish. Custom, pure and simple, causes this waste. Closer utilization is largely in the hands of the lumber consumer. He will derive the benefits for short length lumber can be procured from practically all sawmills at from 60 to 75 per cent of the cost of long lengths.

Distribution Transformer for Signal Power Lines

THE Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has begun the manufacture of small distribution type air-cooled transformers for service, either outdoors or indoors, in connection with the lighting and operation of automatic block signals. They are built in sizes varying from a few watts for small demands up to 2 k.w. capacity, the latter for service at points where the power requirements are relatively large and with primary windings for either 110-volt or 220-volt service. Any desired voltage can be furnished for the low-tension or secondary side.

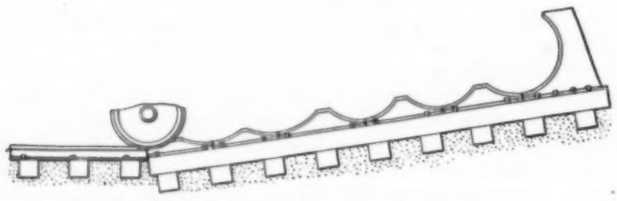
Air Cooled Transformer

In addition to the small capacity types of transformers for signal application, the company is now manufacturing oil-insulated self-cooled transformers that meet railway specifications for power connections to supply sources feeding signal power transmission lines and station lights. They are made in capacities from ¾ to 200 k.v.a. and for supply voltages of 2,300, 3,300, 4,400 and 6,600, as desired. To compensate for variations in voltage due to

the length of supply feeders two 5 per cent taps are furnished on the high tension side. The secondaries are wound for either 110 or 220 volts.

Graduated Sectional Car Stopper

A CAR stopping device, designed to combine all the advantages of a gradual stopper with a definite stop at the extreme end is being placed on the market by the Verona Tool Works, Pittsburgh, Pa. This device, as shown in the drawing, differs from many other car stopping devices in that it does not stop the revolution of the wheels, but



Verona Graduated Sectional Car Stopper

the wheels, changing from the tread to the flange when they engage the stopper, are said to retard the motion by increasing the revolving circumference. In addition to retarding the movement of the car after it engages the device, the stopper in its last or high section brings about a positive stop.

This device, which is known as the Verona car stopper, is said to stop cars at [illegible] which will displace or demolish the ordinary type of car stopper or post.

Hy-Lift Industrial Truck

A 6-TON Hy-lift industrial truck has been developed by the Baker-Rauling Company, Cleveland, Ohio, for handling heavy machine dies and castings at shops, storage sheds and platforms. Both dies and casting have increased greatly in size and weight during the

Baker 6-ton Hy-Lift Truck of Unusually Rugged Construction

past few years and proven rather destructive to trucks designed to carry only two or three-ton loads. The six-ton machine illustrated has been designed with the necessary strength and ruggedness for this work.

The main frame of the truck consists of two 8-in. and two 9-in. channels, tied together by a 1-in. gusset plate. The roller frame is frabricated from four 1-in. plates and the 5/8-in. steel platform is carried by four 8-in. channels. The vertical track on which the roller carriage runs consists of two 8-in. nickel-steel I-beams rolled specially for the Baker Company. The power plant employs a Baker totally enclosed series motor, driving through a worm reduction and full floating axle shafts. The driving axle is connected to the frame by means of the patented duplex compensating suspension, which relieves all axle strains and maintains accurate alinement between the axle and truck frame under all road conditions. The hoist is of the two-cable type and the drums are driven by a compound wound motor through a combination worm and planetary reduction.

When dies are changed by the Hy-lift truck method they are conveniently stored on roller racks three or four tiers high and quickly transferred to and from the truck platform. The very heavy dies should be stored on the floor on skids or on blocks so that the Hy-lift can run underneath the dies and pick them up.

Chemical Plunger Pump

A PLUNGER pump, designed originally to meet the demand for a reliable means of delivering liquids against pressure in measured quantities over a period, is being introduced in the railroad field for injecting measured quantities of chemicals into

Hills-McCanna Corrosion Resisting Plunger Pump

boiler feed water by the Hills-McCanna Company, Chicago.

The positive operation of the single plunger pump as a metering device has long been recognized and is the basis for the design of this pump. It is made in cast iron and steel for handling sodium aluminate, boiler compounds, caustic soda and various water treatments, and in special corrosion-resisting non-ferrous alloys where the service demands this construction.

The standard pumping unit shown has a ¾-in. piston, and the piston stroke can be regulated from 0 in. to 3½ in. in length by easy adjustment on the eccentric arm. A plug for relieving air binding is provided in the pump body, and ball check valves, as illustrated, are provided as regular equipment. The entire device is mounted on a plate fitted with a beaded edge to take care of spillage. Bolting holes for mounting are provided in the base plate.

The stuffing box as well as the entire device is designed for long and efficient service. Drive may be accomplished by a chain, motor drive through reduction gears, or by direct connection to reciprocating pumps.